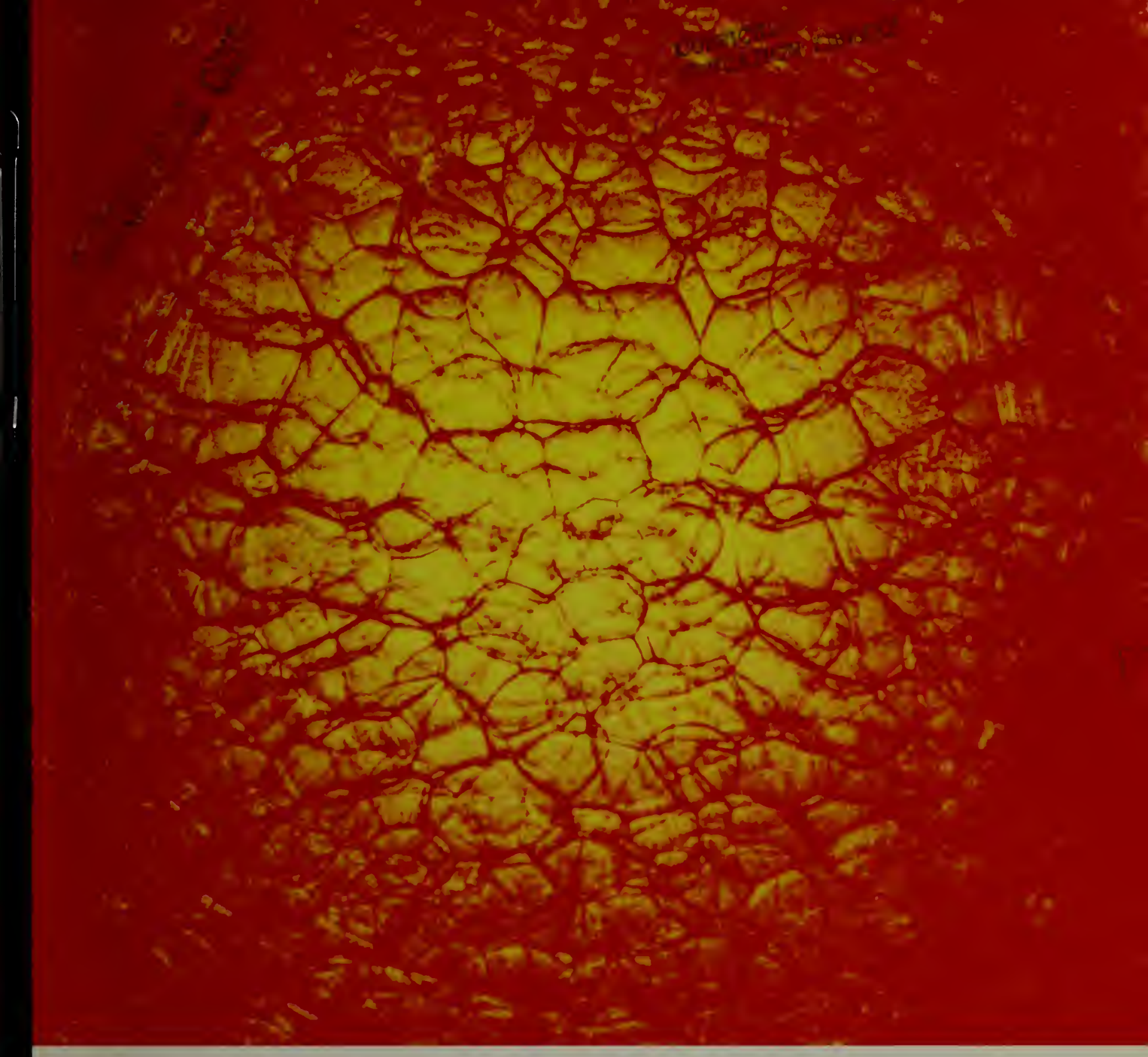

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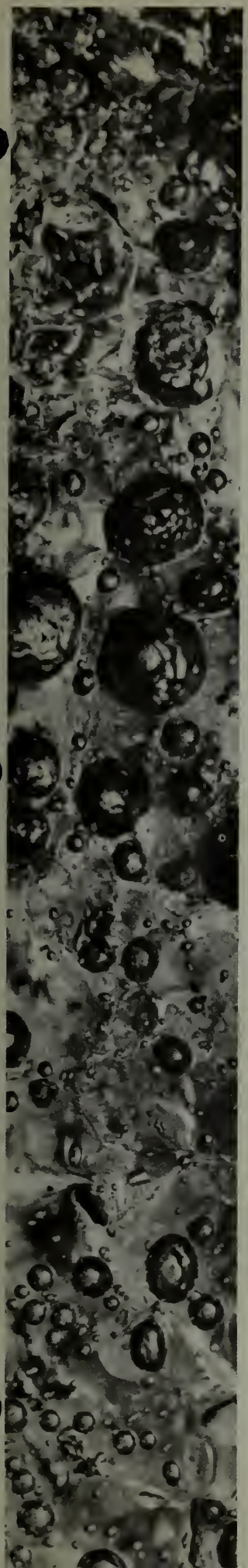

CONTENTS

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NOTE: This curriculum guide is a service publication only. The Junior High School Program of Studies contains the official statement concerning the Junior High Science. The information contained in this guide is prescriptive insofar as it duplicates that which is in the Program of Studies.

Learning resources, other than those prescribed, are to be found in the supplementary publication *Learning Resources--Junior High School Science*.

SCIENCE

OBJECTIVES OF SECONDARY SCHOOL SCIENCE FOR ALBERTA*

The learning of science as an area of human endeavor should provide the student with a scientific literacy which enables him to assume an active and useful role as a citizen in a democratic society. It may be assumed that this literacy is best achieved by considering the individual needs of students and through independent study and learning.

The objectives of Secondary School Science are:

1. To promote an understanding of the role that science has had in the development of societies:
   a. history and philosophy of science as part of human history and philosophy
   b. interaction of science and technology
   c. effect of science on health, population growth and distribution, development of resources, communication and transportation, etc.

2. To promote an awareness of the humanistic implications of science:
   a. moral and ethical problems in the use and misuse of science
   b. science for leisure-time activities

3. To develop a critical understanding of these current social problems which have a significant scientific component in terms of their cause and/or their solution:
   a. depletion of natural resources
   b. pollution of water and air
   c. overpopulation
   d. improper use of chemicals
   e. science for the consumer

4. To promote understanding of and development of skill in the methods used by scientists:
   a. processes in scientific inquiry such as observing, hypothesizing, classifying, experimenting and interpreting data
   b. intellectual abilities such as intuition, rational thinking, creativity, and critical thinking
   c. skills such as manipulation of materials, communication, solving problems in groups, and leadership

5. To promote assimilation of scientific knowledge:
   a. emphasis on fundamental ideas
   b. relevance of scientific knowledge through inclusion of practical applications
   c. application of mathematics in science
   d. interrelationships between the sciences
   e. open-endedness of science and the tentativeness of scientific knowledge

6. To develop attitudes, interests, values, appreciations, and adjustments similar to those exhibited by scientists at work.

7. To contribute to the development of vocational knowledge and skill:

   a. science as a vocation
   b. science as background to technical, professional and other vocations.

*Subject to review in light of the adoption of the Goals of Basic Education by the Government of Alberta.

PHILOSOPHY AND GOALS OF THE JUNIOR HIGH SCIENCE PROGRAM

A. The paramount goal is the student's understanding of the natural world. While understanding cannot be developed in the absence of supporting facts, the memorization of unwarranted detail is to be avoided. However, mastery of a limited number of technical terms is essential for precise communication. The objective is to help in the development of an individual who is aware, informed and concerned about the natural world.

B. The courses are designed to make the student familiar with his natural environment and interrelationships that exist in this environment. Every student should be given the opportunity to pursue investigative activities, and adequate facilities and opportunities should be provided for these activities.

C. Although recommended texts are listed for each course, it is suggested that teachers also make use of the references listed in the supplementary publication (see page 12). It is recommended that teachers exercise professional judgment in ordering references for the school library.

D. The Junior High Science program continues to emphasize skills, concepts, attitudes, and humanistic and social implications of science which have been developed in the elementary program. Content is therefore significant only to the degree that it provides for the realization of other objectives of the program. Student interest should be a significant criterion in the selection of learning experiences.

E. The Junior High Science program further develops, in the context of Life, Earth, and Physical Science, the six conceptual schemes outlined for the Elementary Science program:

1. When energy changes from one form to another, the total amount of energy remains *constant*.

2. When matter changes from one form to another, the total amount remains *constant*.

3. Living things are interdependent with one another and with their environment.

4. A living thing is the product of its heredity and environment.

5. Living things are in constant change.

6. The universe and its component bodies are constantly changing.

The Junior High Science program attempts to provide a background of basic science knowledge for students who may pursue a wide variety of programs, both formal and informal, once they leave grade nine. It is not intended that students be fully prepared for any one high school program, but rather that they be encouraged to explore as widely as possible in response to their interests within the general outline of the program.

MAJOR OBJECTIVES OF JUNIOR HIGH SCIENCE*

1. To develop student awareness of the humanistic and social implications of science. The student should study issues such as these:
   a. evaluation of commercial messages
   b. depletion of non-renewable resources
   c. use and misuse of scientific discoveries.

2. To develop the student's ability to understand and appreciate the nature of science and his role as an investigator and learner. The student should develop:
   a. science process skills
   b. communication skills
   c. interpretative and computational skills based on collected data.

3. To develop student attitudes, interests, values, appreciations and adjustments similar to those exhibited by scientists at work. This may be achieved by involving the student in:
   a. an active program of field experiences
   b. a program of bringing items to the classroom
   c. the use of resource people in the classroom.

4. To have the student develop basic concepts in Life, Earth and Physical Science. In the development of these concepts the student should have practice in:
   a. interpreting and evaluating fundamental ideas
   b. relating scientific knowledge to practical everyday life
   c. dealing with concepts which illustrate the sometimes tentative nature of scientific knowledge.

5. To have the student develop basic skills of, and attitudes toward, safe practices.

*Subject to review in light of the adoption of the Goals of Basic Education by the Government of Alberta.

SKILLS TO BE DEVELOPED IN SCIENCE

PROCESS SKILLS

A key objective of the Junior High Science program is to make the student an increasingly active and dynamic investigator of science--using the processes of the scientist. Through conscious, systematic development of these processes, the student becomes increasingly better equipped for more complex learning in the fields of science as well as in other areas of investigation.

The following processes are considered to be an essential part of the student's learning:

a. observing--using all the senses

b. classifying--grouping related objects or ideas

c. quantifying--using numbers and measurements

d. communicating--using such means as discussion, tabulation, graphing . . .

e. inferring

f. predicting

g. formulating hypotheses

h. defining terms

i. controlling variables

j. interpreting data and results

k. formulating models--verbal, pictorial, and concrete

l. experimenting--planning and designing an investigation

m. processing of data--organizing, representing graphically, treating mathematically

n. identifying problems

o. seeking further evidence

p. applying discovered knowledge

Information on pages 7 to 10 is taken from AAAS, *Commentary for Teachers*, by the American Association for the Advancement of Science. It may prove to be useful in helping students learn some of the above processes.

Process	Description of Behavior	Example Activities
Observing	The desired pupil behavior is increasing competence in using not only his sense of sight but also his other senses of hearing, touch, smell and taste.	These may involve both oral and written descriptions of the following: identify and name colors, textures, relative sizes and other properties of objects; distinguish difference in temperature; read temperature on a thermometer; identify and name factors in weather such as temperature and precipitation; identify possible causes of change such as temperature and precipitation; identify possible causes of change such as heat, wind and air pressure; show the effect or cause of change on an object such as a balloon; describe selected items so that others can identify and name the main parts of a plant; describe plant growth over a period of time; describe the relationship between two variables.
Classifying	The desired pupil behavior is increasing competence in grouping articles, objects and ideas on the basis of some observable property or properties.	Objects may be classified according to smoothness, texture, color, and special characteristics. Single-stage classifications are followed by two-stage and multi-stage classifications.
Quantifying	The desired pupil behavior is increasing competence in measuring length, weight, area, volume, and rate of change of the physical world.	The following are illustrative: distinguish objects by using such terms as heavier and lighter; identify relative weight by lifting; use a balance to distinguish heavier from lighter objects; use standard units of weight;

Process	Description of Behavior	Example Activities
		explain effects of gravitation and inertia; measure the weight of various objects; describe differences in weights; identify, state and demonstrate differences in perception of weight.
Formulating Hypotheses	The desired pupil behavior involves developing increasing competence in stating an hypothesis regarding causes of phenomena or the relationship between two variables. An hypothesis tells how to observe an expected outcome of an experiment.	The following illustrate hypotheses: 1. If the air pressure inside is less than the air pressure outside a tube, then water will rise in the tube. 2. If a ball is dropped, its speed will increase as it approaches the floor.
Making Operational Definitions	The pupil should demonstrate increasing competence in stating the minimum things to do or look for in order to identify the subject being defined.	The following are illustrative: cold means 15°C for this experiment; little friction means that not more than an additional 10% of force over and above the weight of the object is required to move the object across a surface.
Controlling and Manipulating Variables	The desired pupil behavior is increasing competence in arranging conditions to be able to deliberately control and manipulate objects or conditions in an experiment.	The following examples are illustrative: 1. Consider two pendula swinging at different rates. Variables to control might include: the weights (size, shape, and mass), the string (length and thickness), and the length of swing. 2. Metals expand when heated. Variables to control might include: kind of metal and the temperature.

Process	Description of Behavior	Example Activities
Interpreting Data	The desired pupil behavior is increasing competence in getting the most out of data without over-simplifying, drawing conclusions supported by the data, and considering alternative explanations.	Interpretations may be drawn from observations made in the form of verbal statements, graphs, histograms, and tables.
Formulating Models	The desired pupil behavior is increasing competence in building both physical and mental models to account for phenomena.	The following models are illustrative: 1. Pictures of the moon's surface. 2. Diagrams of the life cycle of an insect. 3. Physical model of a chromosome. 4. Mental model--idea of an atom.
Communicating	The desired pupil behavior is increasing competence in describing an experiment so that an individual who has not seen it can carry it out.	Experiences in identifying and naming objects are followed by graphing and describing measured changes as shown in the following examples: identify and name events that can be quantified, such as five bounces of a ball; make a column in a bar graph to represent the frequency of an event; distinguish events shown in a graph; make a bar graph; describe measured changes in speed, temperature, and other properties; make a prediction on the basis of recorded measures; make a graph to show the prediction; describe an experiment so that others might do it.
Inferring	The desired pupil behavior is increasing competence in drawing more than one inference from a set of data, demonstrating that	The following sequence is illustrative. Use the concept "evaporation" to explain how water is lost by plants; demonstrate a

Process	Description of Behavior	Example Activities
	inference can be tested by further observation, and demonstrating that an inference can be tested by applying known tests to the properties of objects. Pupils should indicate that they are able to distinguish between observations and inferences.	way to measure the water used by a plant; infer and demonstrate that water drawn through plants is transferred to the atmosphere; show that an inference may be tested by additional observations.
Predicting	The desired pupil behavior is increasing competence in conducting experiments to test predictions of relationships between two measurable quantities.	Various tasks might include: plotting data, making and interpreting graphs, and observing from different vantage points. For example, analyze a graph to determine the pattern relationships (increasing, decreasing, stable); use a graph to predict water loss from plants; make predictions from a series of observations by means of graphs; conduct an experiment to test predictions.
Experimenting	The desired pupil behavior is increasing competence in planning, conducting and communicating experiments in which the problem is clarified, hypotheses are stated, observations are made, and data interpreted. This process depends upon the pupil being able to use all of the other processes.	Pupils might develop experiments to answer the following questions: 1. How do mealworms react to light? 2. How many nails can a magnet lift? 3. What happens to salt when it is placed in water? Does more salt dissolve in water at 35°C than at 20°C?

MOTOR SKILLS

In order to develop manipulative skills, students in Junior High Science must have frequent opportunities for first-hand investigative experiences that involve the handling of materials and equipment.

ATTITUDES TO BE DEVELOPED

Much of the spirit and meaning of science is transmitted to students from the teacher. Some of the attitudes the teacher should endeavor to develop in students are:

1. Curiosity and interest
2. Intellectual honesty
3. Open-mindedness
4. Belief in cause-effect relationships
5. Suspended judgment when data is inadequate
6. A respect for accuracy and precision
7. Skepticism of statements which may be biased or based on inadequate information.

IMPORTANT GUIDELINES

A. Organization of Program for Grades 7,8 and 9

Approximately 80 hours of instructional time shall be devoted to the core topics and approximately 20 hours to elective topics. Content of the elective units is to relate to the core in one of three ways:

a. an extension of a core topic (breadth)

b. an in-depth, intensive study of a core topic

c. a practical application of a core topic.

B. Controversial Issues in the Classroom

The presentation of issues of a potentially sensitive nature such as those related to human reproduction, special creation, or genetic manipulation are to be dealt with in accordance with the 1972 policy statement included on pages 13 and 14 of this guide, or to local policy which is in accord with the principles of the 1972 policy statement.

The intent of the policy statement is to develop students' capacities to think clearly, reason logically, and examine issues from several points of view. In addition, care should be taken that theories are not presented as fact.

C. Local Selection of Instructional Materials

Teachers are reminded that they are responsible to their employing boards for the classroom use of materials that are not prescribed by either Alberta Education or by the School Board. The procedures to be used in seeking authorization to use other than prescribed references are described in the Curriculum Bulletin (Volume 8, No. 1, Feb., 1975) describing changes in legislation relative to local selection of instructional materials and development of curricula.

Learning Resources

Only the texts currently prescribed by the Minister of Education are listed in this publication. Other references for both core and electives are listed in a companion publication entitled *Learning Resources (for) Junior High School Science.*

CONTROVERSIAL ISSUES

In August 1972, the Minister of Education announced a policy regarding controversial issues. This announcement was in response to representation having been made regarding the treatment in school programs of such matters as Canadian content, family life education, sex-stereotyping and special creation, to name a few. By way of interpretation, the policy is to be treated as a whole; that is, no clause is to be applied in isolation of any other clause or clauses in the policy. The policy is intended to accomplish the following in the handling of issues such as those mentioned above.

1. Provincially, it will:

    a. guide the development and revision of Programs of Study, including the acquisition of support materials.

    b. serve as the Department of Education position in cases in which the department may be consulted regarding controversial issues.

2. Locally, the statement is to serve as a guide for the development of policy at system, district or school levels, according to local choice.

DEPARTMENT OF EDUCATION POLICY

Re: Controversial Issues in the Classroom

I. In principle, it is an objective of the Alberta educational system to develop students' capacities to think clearly, reason logically, examine all issues and reach sound judgements.

II. The specific policy, based on this principle, is:

1. Students in Alberta classrooms should not be ridiculed or embarrassed for positions which they hold on any issue, a requirement which calls for sensitivity on the part of teachers, students and other participants in dealing with such issues.

2. Students should have experiences in selecting and organizing information in order to draw intelligent conclusions from it. For sound judgements to be made, information regarding controversial issues should:

a. represent alternative points of view;

b. appropriately reflect the maturity, capabilities and educational needs of the students and reflect the requirements of the course as stated in the program of studies;

c. reflect the neighborhood and community in which the school is located, but not to the exclusion of provincial, national and international contexts.

3. School trustees should establish, in consultation with appropriate interest groups, policies regarding:

   a. identification of controversial issues,

   b. treatment of such issues in local classrooms.

4. Students, teachers and administrative staff should have a voice in determining:

   a. the controversial issues to be studied,

   b. the texts and other materials to be used,

   c. the manner in which such issues are dealt with in the classroom.

SUGGESTIONS FOR IMPLEMENTING THE SCIENCE PROGRAM

A. An Approach to the Teaching of Junior High School Science

Nature of Science

Today's science programs emphasize inductive modes of inquiry. In the past, much science teaching in the junior high school has treated science as dogma. To a large degree, the difference stems from one's definition and view of science. In oversimplified terms, when science is regarded as an accumulation of facts, it is defensible to design curricula with the goal of creating the most efficient scheme for teaching these facts. On the other hand, when science is regarded as an active, human process for acquiring knowledge, curricula must be designed to bring the learner into a direct encounter with this process. The substance of inductive inquiry is data; data and concepts are essential ingredients of inquiry. However, they are not the totality of science; processes of inquiry must be included and balanced against content.

In today's junior high science programs, inquiry involves human activity in search of meaning. It involves both the student and the teacher in an active process. Recitation followed by student feedback would seem to be antithetical to the process of inquiry. Science is a body of knowledge and a process of inquiry.

Students should be given opportunities to recognize, understand, and evaluate the social and environmental consequences of scientific discoveries. The humanistic view of science should receive substantial emphasis. In order for students to understand the significance of science in the progress of civilization, they should be challenged to bring scientific considerations into social issues.

Process Skills

Strong recognition must be given to process. However, process skills should not be developed simply for their own sake. Rather, process skills, including observing, interpreting, and hypothesizing, should be developed as an integral part of programs and used as they are required by the student to gain and process data and information to develop concepts.

Concept Formation

It is important for the teacher to remember that a concept is a gradually-developing and continuous verbal and mental image which is unique to each student. Concepts are not taught directly by the teacher, but are primarily the result of mental and physical activity on the part of the learner. Experiences with real things should be presented within a conceptual framework.

B. Use of Textbooks

All too often a textbook has been accepted in many classrooms as the program of studies. Experience has shown that the use of a single text has resulted in problems when teachers attempt to meet the range of individual abilities. One must consider both the strengths and limitations of a textbook and exercise discretion in its use. The use of a variety of texts helps to provide alternate methods and approaches to accommodate ranges of performance and interest. No text, manual, or single aid will provide a creative and appealing approach to instruction. Children differ and communities are varied, so that the creative ability and background of children demand variation in instructional patterns.

C. Student Evaluation

The nature of the Junior High Science course, i.e., an activity-centered science course geared to providing successful student experiences, calls for different kinds of teaching and evaluating. Too often we assume that students have skills and are able to use scientific processes. These skills and processes must be taught, practiced, and evaluated. This evaluation should be continuous with maximum student participation.

Evaluation should be concerned with the attainment of conceptual knowledge but there should also be a large component concerned with the attainment of the affective goals. That is to say, we must attempt to measure not only the pupil's growth in the knowledge dimension but also in the attitudinal dimension.

D. Safety and Maintenance of the Science Laboratory

1. Teachers should be aware of potential hazards incumbent in any experiment or demonstration which is to be incorporated into the science program.

2. Students should be made aware of hazards in doing any experiment and should be made to understand and follow the directions.

3. Chemicals should be stored in a safe, secure and orderly manner.

4. All laboratory activities should be supervised.

5. Students should be taught how to use and care for laboratory equipment.

6. All apparatus and equipment should be in good repair.

7. Safety equipment (fire extinguishers, asbestos blankets, eye washers, first aid kits, etc.) should be readily accessible. Students should be instructed in the proper use of this equipment.

8. Teachers should be conversant with the policies and statements adopted by their employing board. In the absence of such statements, teachers should be aware of specific hazards that students face in the science program and have taken suitable precautions against such hazards.

9. All accidents should be reported to the principal without delay.

10. The use of vertebrate animals for experimental work is to be avoided.

SUGGESTIONS REGARDING A FIELD STUDIES PROGRAM

Field tripping or outdoor education as a valuable contributing component to any total educational program in our Alberta schools is now recognized and accepted. Nevertheless, schools or classes contemplating such activities must bear in mind certain responsibilities. The statement which follows is to alert teacher, principals, administrators, and others to assure that all necessary steps are taken to ensure success.

A good deal of literature, local and otherwise, now exists on this topic and those undertaking field tripping for the first time would be well advised to avail themselves of this information where possible. Adequate pre-planning is the key to a successful field trip, whether it be of short or long duration; whether it be taking students a few hundred yards or several hundred miles.

A field trip must be based on clearly defined objectives. Since field tripping requires an expenditure of a great deal of time and often money, the results to students should at all times justify the efforts necessary.

In setting objectives and in pre-planning the undertaking, many important considerations have to be taken into account. Some of these relate to the age of the students, parents' consent, compliance with board policies, and adequate and responsible adult supervision. There are many others.

It is not the intent of this publication to cover fully the topic of field tripping or outdoor education. The intent is to suggest that field tripping cannot be undertaken lightly and that careful planning must precede any such activity.

The following check list is included as a sample guide in suggesting the kinds of items which should receive attention.

FIELD STUDIES CHECK LIST*

(Not all-inclusive and only suggestive)

( ) 1. The objectives of the field trip have been clearly identified.

( ) 2. The field trip site has been visited and studied.

( ) 3. Field trip site entry has been cleared and booked.

( ) 4. Students who will participate have been identified.

( ) 5. An outline of student activities has been prepared.

( ) 6. Permission from the proper school authorities has been obtained (school board included).

( ) 7. Parental consent has been obtained in writing.

( ) 8. All financial commitments have been looked after.

( ) 9. All teachers whose classes may be affected have been properly consulted.

( ) 10. Any required student skills have been taught.

( ) 11. Proper and adequate transportation has been arranged.

( ) 12. A full schedule of times and events has been prepared, including departure and arrival time.

( ) 13. Adequate and responsible adult supervisory personnel have been provided for.

( ) 14. First aid requirements have been met.

( ) 15. Proper clothing requirements have been established.

*Adapted from A Guide to Field Tripping, Calgary Board of Education.

( ) 16. Guidelines for behavior have been established for all.

( ) 17. Proper and adequate food supply has been assured.

( ) 18. Duties and responsibilities of all supervisory personnel have been outlined.

( ) 19. Supplies and equipment for all have been identified and arranged for.

( ) 20. Safety precautions have been outlined.

FOLLOWING UP ON A FIELD TRIP

It is generally accepted that follow-up activities are of equal importance to those in the field. Some follow-up activities might include reporting by various committees on the data collected, organizing and reviewing ideas and materials gathered, preparing bulletin board displays, demonstrations and worksheets, and discussing, testing and identifying specimen materials obtained. Each student should have some responsibility in interpreting and explaining what was observed.

EVALUATION

The teacher should attempt to determine the extent to which his other purposes for taking the field study were met. Evaluation might include completed questionnaires, student prepared booklets, and evidence that might be collected to support the general objectives of Junior High Science. Problems that arose should be noted for revision of plans for future trips. Some attempt should also be made to determine the usefulness of the resource site for future field studies.

Life Science

7

Prescribed References

Carter, J. L. et al, *Life Science: A Problem Solving Approach*, Scarborough: Ginn and Co., 1977

Smallwood, W. L., *Challenges to Science: Life Science* Scarborough: McGraw-Hill, 1976

Learning Resources

For learning resources appropriate to each elective, refer to *Learning Resources--Junior High School Science*, the supplementary publication to this guide.

Objectives

After participating in the activities and completing the assignments associated with this course, the student should be able to:

7.1 Demonstrate a knowledge of and be able to discuss the identified major concepts and their subconcepts within the context of a study of life science. These major concepts are:

- 7.1.1 All sets of objects including living things may be classified into groups having common characteristics.
- 7.1.2 Cells are the unit of structure and function of most living things.
- 7.1.3 Living things carry on certain fundamental processes to sustain and perpetuate life.
- 7.1.4 All living things interact with and are interdependent upon each other and their environment.

7.2 Acquire such investigative skills associated with science as:
--observing with all the senses
--classifying related objects or ideas
--quantifying measured data
--manipulating data to identify the patterns
--identifying problems clearly so that the variables may be controlled or manipulated
--interpreting data, making inferences leading to hypotheses and predicting future behavior.

7.3 Identify and discuss the limitations of experimental data in terms of the underlying assumptions and the identified problem.

7.4 Assume a responsibility for keeping the workspace neat and tidy by practicing safe, and careful, work habits.

7.5 Recognize and be able to cite examples of the contributions made by such historical figures as Robert Hooke, Louis Pasteur.

7.6 Investigate factors related to the wise use of renewable resources and man's impact upon the environment.

DEFINITIONS FOR GRADE SEVEN SCIENCE

(Arranged topically)

The following definitions are included to aid the teachers of the Grade 7 Science Program.

A. Life Processes

1. Adaptation - a characteristic which particularly suits an organism for survival in its environment.

2. Digestion - the process of breaking down food into nutrients.

3. Reproduction - the process by which any organism makes more of its kind.

4. Respiration - the oxidation of sugar in living organisms.

5. Sensitivity - the reaction of an organism to its internal and external environment.

B. Interaction of Living and Non-Living Things

1. Biosphere - the largest community, including all forms of life on earth.

2. Community - a group of plant and animal populations which lives and interacts in a particular area.

3. Ecosphere - the total physical environment of the Earth, including the atmosphere around it.

4. Ecosystem - a community together with its physical environment.

CORE 7

CONCEPT	SUBCONCEPT
C7.1 All sets of objects including living things may be classified into groups having common characteristics.	Classification makes thinking about a large number of things simpler and easier. a. Within large groups, members share some common characteristics; within smaller subgroups, members share a greater number of common characteristics. b. Living things may be classified as protist, plant, or animal.
C7.2 Cells are the unit of structure and function of most living things.	1. The techniques and tools of scientists aid in observing things. Microscopes are required to study cells. 2. Plant and animal cells share many common characteristics. 3. Cells live independently or in groups. a. Single-celled organisms perform all the functions necessary for life. b. Some cells in multicellular organisms are specialized to carry out specific functions.
C7.3 Living things require energy to carry on certain fundamental processes in order to sustain life.	1. Organisms require nutrients for energy. a. Green plants use the sun's energy to produce food. b. Energy from stored food is usable when organisms break down food into nutrients. Some basic foods are starch, sugar, protein, fats and oils. c. All living things obtain their energy from respiration. i. Organisms obtain oxygen from their environment in a variety of ways. ii. Oxygen enables organisms to burn food for energy.

CONCEPT	SUBCONCEPT
	d. Food products and gases must be available to all cells throughout an organism. i. Cells receive nourishment and eliminate waste through the process of diffusion. ii. More complex organisms show a need for specialized circulatory systems.
	2. Energy enables organisms to carry out activities in order to sustain life. a. Organisms obtain nutrients in a variety of ways. b. Growth of an organism may result in change in structure or proportion, or an increase in size. c. Organisms react to their internal and external environment. i. Different species may have different ways of receiving and responding to stimuli. ii. Organisms differ in their adaptation to the environment. d. Organisms must reproduce to ensure survival of the species. i. Organisms may reproduce sexually, asexually, or by both means. ii. An offspring inherits certain characteristics from its parents. iii. There are many variations within a population.
C7.4 All living things interact with and are interdependent with each other and their environment.	1. Life on our planet is possible in the biosphere. a. Living and non-living things interact within ecosystems. b. Communities of organisms exist within the ecosystems.
	2. The members of each community show adaptations which are necessary for survival in the community.

CONCEPT	SUBCONCEPT
	a. Some organisms are specific to certain communities (distribution).
	b. Some organisms may exist in more than one community (tolerance).
3. An organism is the product of both heredity and environment.	
4. The environment and the distribution of organisms are in a state of continual change.	
	a. Nature constantly recycles materials.
	b. Changes may take place over an extended period of time.

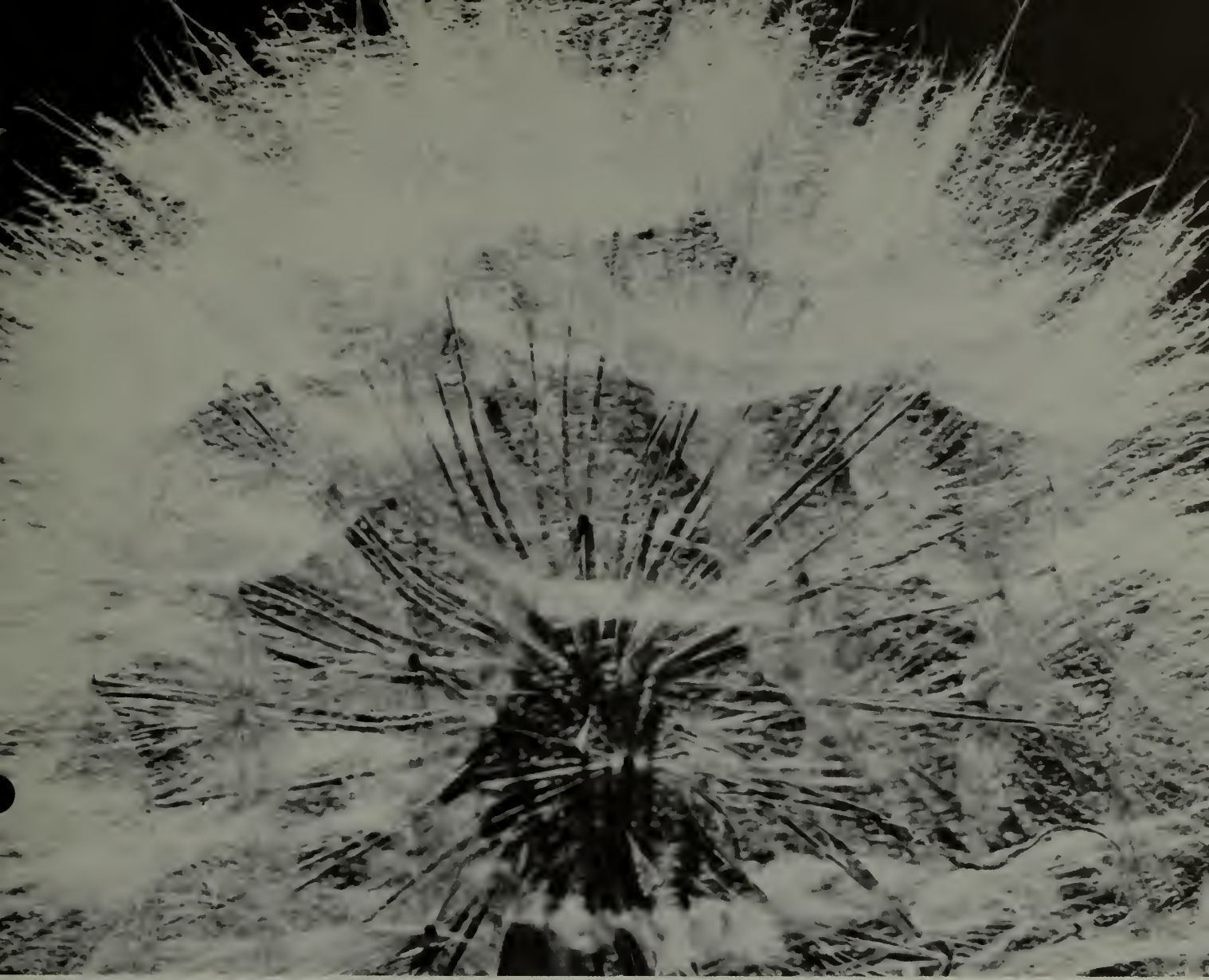
CORE CONCEPT REFERENCE GRID -- KEYED TO PRESCRIBED REFERENCES

	CONCEPTS		*Life Science-- A Problem Solving Approach*	*Challenge to Science-- Life Science*
			(pages)	(pages)
C7.1	All sets of objects including living things may be classified into groups having common characteristics.	Classification makes thinking about a large number of things simpler and easier.	42-53	
		a. Within large groups, members share some common characteristics; within smaller subgroups, members share a greater number of common characteristics.		
		b. Living things may be classified as protist, plant, or animal.		
C7.2	Cells are the unit of structure and function of most living things.	1. The techniques and tools of scientists aid in observing things.	69-87	
		Microscopes are required to study cells.		
		2. Plant and animal cells share many common characteristics.	88-106	62-69
		3. Cells live independently or in groups.	107-123	81-95
		a. Single-celled organisms perform all the functions necessary for life.		
		b. Some cells in multicellular organisms are specialized to carry out specific functions.		

C7.3	Living things require energy to carry on certain fundamental processes in order to sustain life.	1. Organisms require nutrients for energy.		
		a. Green plants use the sun's energy to produce food.	257-276	43-44
		b. Energy from stored food is usuable when organisms break down food into nutrients.	316-318 333-337 365-381	99-106
		Some basic foods are starch, sugar, protein, fats and oils.		
		c. All living things obtain their energy from respiration.	204-208 306-314	106-109
		i. Organisms obtain oxygen from their environment in a variety of ways.		
		ii. Oxygen enables organisms to burn food for energy.		
		d. Food products and gases must be available to all cells throughout an organism.	231-256 329-332	110-118
		i. Cells receive nourishment and eliminate waste through the process of diffusion.		
		ii. More complex organisms show a need for specialized circulatory systems.		
		2. Energy enables organisms to carry out activities in order to sustain life.		

a. Organisms obtain nutrients in a variety of ways.	128-138 151-158 195-196 257-276 320-323	280-282 286-287 292, 296 299, 328 331, 333 341, 371
b. Growth of an organism may result in change in structure or proportion, or an increase in size.	192-204 299-301	179-194 363-365
c. Organisms react to their internal and external environment.	131-146 147-158 167-174 211-230 299 302-304	121-137
i. Different species may have different ways of receiving and responding to stimuli.		
ii. Organisms differ in their adaptation to the environment.		
d. Organisms must reproduce to ensure survival of the species.	159-166 277-293	139-177 305-323
i. Organisms may reproduce sexually, asexually, or by both means.		
ii. An offspring inherits certain characteristics from its parents.		
iii. There are many variations within a population.		

C7.4 All Living things interact with and are interdependent with each other and their environment.	1. Life on our planet is possible in the biosphere.		
	a. Living and non-living things interact within ecosystems.		39-43 405-419 435-449
	b. Communities of organisms exist within the ecosystems.	354-358 361-364	43-52 275-288 291-303
	2. The members of each community show adaptations which are necessary for survival in the community.	358-361	19-23 377-400
	a. Some organisms are specific to certain communities (distribution).		
	b. Some organisms may exist in more than one community (tolerance).		
	3. An organism is the product of both heredity and environment.	341-353 365-381	161-177 199-241
	4. The environment and the distribution of organisms are in a state of continual change.	361-364	29-37
	a. Nature constantly recycles materials.		
	b. Changes may take place over an extended period of time.		



ELECTIVES 7

GRADE 7 SCIENCE ELECTIVES

The principles to be applied when choosing topics are:

1. The time available is a minimum of 20 hours.

2. The content is related to the core in one of three ways:

   a. An extension of a core topic (breadth).

   b. An in-depth, intensive study of a core topic. (Caution: The topic should not be developed to the extent that is found at a higher grade level.)

   c. A practical application of a core topic.

Learning Resources

For learning resources appropriate to each elective, refer to *Learning Resources--Junior High School Science*, the supplementary publication to this guide.

Elective Topics

A minimum of one elective topic chosen from the following list is to be studied.

E7.1 Mankind's influence may increase the rate of change, with beneficial or harmful results to the environment.

E7.2 Mankind commands the use of a great supply of energy to change the environment to his liking.

E7.3 Pollution due to mankind's production and use of energy can be minimized.

E7.4 The preservation of mankind's biological resources depends on the awareness and positive action of each individual.

E7.5 A simple key may be used to facilitate identification of organisms.

E7.6 A locally developed unit.

Note: Outlines for each elective, with the exception of E7.6 are provided in the Curriculum Guide.

E7.1

MANKIND'S INFLUENCE MAY INCREASE THE RATE OF CHANGE WITH BENEFICIAL OR HARMFUL RESULTS TO THE ENVIRONMENT

Content:

1. Mankind is able to change the landscape far faster than geological and biological processes.

2. Growth in our population has increased the demand on the environment.

3. Automobiles have had a great effect on the environment.

4. Changes in living space occur since more people choose to live in urban areas rather than rural areas.

5. Increases in leisure time and wealth have changed our demands on the environment.

6. Mankind produces enormous quantities of waste--body wastes, garbage, discarded machinery.

7. Mankind uses chemicals to control pests.

References:

Refer to Elective Concept Reference Grid page 41 .

E7.2

MANKIND COMMANDS THE USE OF A GREAT SUPPLY OF ENERGY TO CHANGE THE ENVIRONMENT TO HIS LIKING

Content:

1. Some resources cannot be used without destroying them (non-renewable resources such as fossil fuels).

2. Some resources can be so damaged that they become useless (renewable resources such as water, soil and forests).

3. Conservation enables mankind to use resources wisely.

   a. Soil conservation occurs through minimizing erosion, preventing overgrazing, using contour strip farming, and maintaining fertility.

   b. Forest conservation occurs through forest fire prevention, control of diseases and pests, protection from grazing, and wise lumbering.

   c. Water conservation enables us to reuse water.

References:

Refer to Elective Concept Reference Grid page 42 .

E7.3

POLLUTION DUE TO MANKIND'S PRODUCTION AND USE OF ENERGY CAN BE MINIMIZED

Content:

1. Thermal pollution can cause the death of many aquatic organisms.
2. Rivers and other bodies of water can handle small amounts of pollution.
3. Combustion causes most of our air pollution.
   a. A temperature inversion can increase pollution.
   b. Fog can increase air pollution.
4. Pollutants can damage organs of the breathing system. (Diseases may be caused by air pollution.)

References:

Refer to Elective Concept Reference Grid page 42 .

E7.4

THE PRESERVATION OF MANKIND'S BIOLOGICAL RESOURCES DEPENDS ON AN AWARENESS AND THE POSITIVE ACTION OF EACH INDIVIDUAL

Content:

1. The environment is viewed in terms of both economic and aesthetic value.

2. Changes in the environment may be reversible or irreversible.

3. Whenever possible, a resource should be used to meet several types of interests.

4. Some areas have been classified as wilderness areas.

5. Land can be classified as being suitable for agriculture--care that should be given it.

6. Recycling of paper, oil, and glass can reduce mankind's impact on the environment.

References:

Refer to Elective Concept Reference Grid page 43 .

E7.5

A SIMPLE KEY MAY BE USED TO FACILITATE IDENTIFICATION OF ORGANISMS

Content:

1. Identification of a living thing can be made by observing its structure.

2. A classification key helps to identify an organism by considering the presence or absence of many characteristics that the organism might possess.

3. A dichotomous key, based on characteristics that will separate living things into groups, can be developed.

References:

Refer to Elective Concept Reference Grid page 43 .

ELECTIVE CONCEPT REFERENCE GRID -- KEYED TO PRESCRIBED REFERENCES

	CONCEPTS		*Life Science-- A Problem Solving Approach*	*Challenges to Science-- Life Science*
E7.1	Mankind's influence may increase the rate of change with beneficial or harmful results to the environment.	1. Mankind is able to change the landscape far faster than geological and biological processes.		
		2. Growth in our population has increased the demand on the environment.		
		3. Automobiles have had a great effect on the environment.	(Refer to "Learning Resources - Junior High School Science)	
		4. Changes in living space occur since more people choose to live in urban areas rather than rural areas.		
		5. Increases in leisure time and wealth have changed our demands on the environment.		
		6. Mankind produces enormous quantities of waste--body wastes, garbage, discarded machinery.		
		7. Mankind uses chemicals to control pests.	385-386	26-29 33-35 52-54

E7.2	Mankind commands the use of a great supply of energy to change the environment to his liking.	1. Some resources cannot be used without destroying them (non-renewable resources such as fossil fuels).		
		2. Some resources can be so damaged that they become useless (renewable resources such as water, soil and forests).		
		3. Conservation enables mankind to use resources wisely.		
		a. Soil conservation occurs through minimizing erosion, preventing overgrazing, using contour strip farming, and maintaining fertility.	(Refer to "Learning Resources - Junior High School Science)	
		b. Forest conservation occurs through forest fire prevention, control of diseases and pests, protection from grazing, and wise limbering.		
		c. Water conservation enables us to reuse water.		
E7.3	Pollution due to mankind's production and use of energy can be minimized.	1. Thermal pollution can cause the death of many aquatic organisms.		256-257
		2. Rivers and other bodies of water can handle small amounts of pollution.	383-384 386-393	248-256 258-261
		3. Combustion causes most of our air pollution.	384-385 393-395	262-267
		a. A temperature inversion can increase pollution.		

		b. Fog can increase air pollution.		
		4. Pollutants can damage organs or the breathing system. (Diseases may be caused by air pollution.)		244-245 267-270
E7.4	The preservation of mankind's biological resources depends on an awareness and the positive action of each individual.	1. The environment is viewed in terms of both economic value and aesthetic value. 2. Changes in the environment may be reversible or irreversible. 3. Whenever possible, a resource should be used to meet several types of interests. 4. Some areas have been classified as wilderness areas. 5. Land can be classified as being suitable for agriculture and the care that should be given it. 6. Recycling of paper, oil and glass can reduce mankind's impact on the environment.	(Refer to "Learning Resources - Junior High School Science)	
E7.5	A simple key may be used to facilitate identification of organisms.	1. Identification of a living thing can be made by observing its structure.	55	377-401
		2. A classification key helps to identify an organism by considering the presence or absence of many characteristics that the organism might possess.	55-61	316-321

3.	A dichotomous key, based on characteristics that will separate living things into groups, can be developed.	62-65

EARTH SCIENCE

8

Prescribed References

Heller, R. L. et al, *Challenges to Science: Earth Science*. Scarborough: McGraw-Hill, 1976.

Jackson, J. H. and E. D. Evans, *Spaceship Earth: Earth Science*. Markham: Houghton-Mifflin,1976.

Learning Resources

For learning resources appropriate to each elective, refer to *Learning Resources--Junior High School Science*, the supplementary publication to this guide.

Objectives

After participating in the activities and completing the assignments associated with this course, the student should be able to:

8.1 Demonstrate a knowledge of and be able to discuss the identified major concepts and their associated subconcepts within the context of a study of the earth. These major concepts are:

- 8.1.1 A perspective of the position and motion of the Earth in space is gained by celestial observations and measurements.
- 8.1.2 Various theories attempt to explain the origin of the solar system and the universe.
- 8.1.3 The Sun is a typical star.
- 8.1.4 Solar gravity and planetary inertia maintain a system of planets in orbit.
- 8.1.5 The surface of the Earth and its inhabitants are surrounded by an atmosphere of air.
- 8.1.6 Local conditions in the atmosphere are referred to as weather.
- 8.1.7 The crust of the Earth is formed of rocks.
- 8.1.8 The crust of the Earth is constantly being changed.

8.2 Demonstrate increasing competence in the investigative skills associated with science:

--observing with all of the senses
--manipulating technical instruments
--collecting reliable data
--manipulating the data to identify any patterns
--interpreting data, making inferences leading to hypotheses, and predicting future behavior.

8.3 Participate in a study of some local phenomenon such as the weather patterns over a period of time, collect the data and relate these to the regional patterns and the long-term climatic conditions.

8.4 Recognize and be able to cite the contributions to modern theories of such scientists as Galileo, Kepler, Hutton and Wegener.

8.5 Examine topics of current scientific interest in an objective and open-minded manner.

DEFINITIONS FOR GRADE EIGHT SCIENCE

(Arranged topically)

The following definitions are included to aid the teachers of the Grade 8 Science Program.

A. Space

1. Galaxy - an assemblage of millions or billions of stars, gas, and dust in space.

B. Atmosphere

1. Air - another term for atmosphere, particularly that mixture of its gases close to the Earth's surface.

2. Conduction - the transfer of heat energy in a solid by vibration from one molecule or particle to another.

3. Convection - the transfer of heat energy through a gas or a liquid by motion of the particles in the substance.

4. Radiation - one of the kinds of energy given off by hot objects.

C. Weather

1. Air mass - a large body of air with similar temperature and humidity at all levels.

2. Cold front - a cold air mass invades warmer, pushes under the warmer air and often produces cumulus clouds.

3. Cyclone - an eddy with winds that blow counterclockwise in the northern hemisphere into and around a center of low atmospheric pressure.

4. Eddy - a circular motion in air or water.

5. Precipitation - any water, solid or liquid, that falls from the atmosphere to the ground.

6. Relative humidity - the actual amount of water vapor in the air compared to the total amount of water vapor the air could hold at that temperature, expressed as a percentage.

7. Warm front - a warm air mass pushes into a region of cold air, rides over the cold air mass and often produces high cirrus clouds.

8. Weather - the state of the air at a given time in terms of temperature, pressure, precipitation, wind, and visibility.

D. The Earth's Crust

1. Chemical weathering - weathering that changes the particle size of a material and also changes the material itself into something else due to exposure to air and water.

2. Erosion - the process of wearing down the landforms by carrying away weathered rock particles or soil.

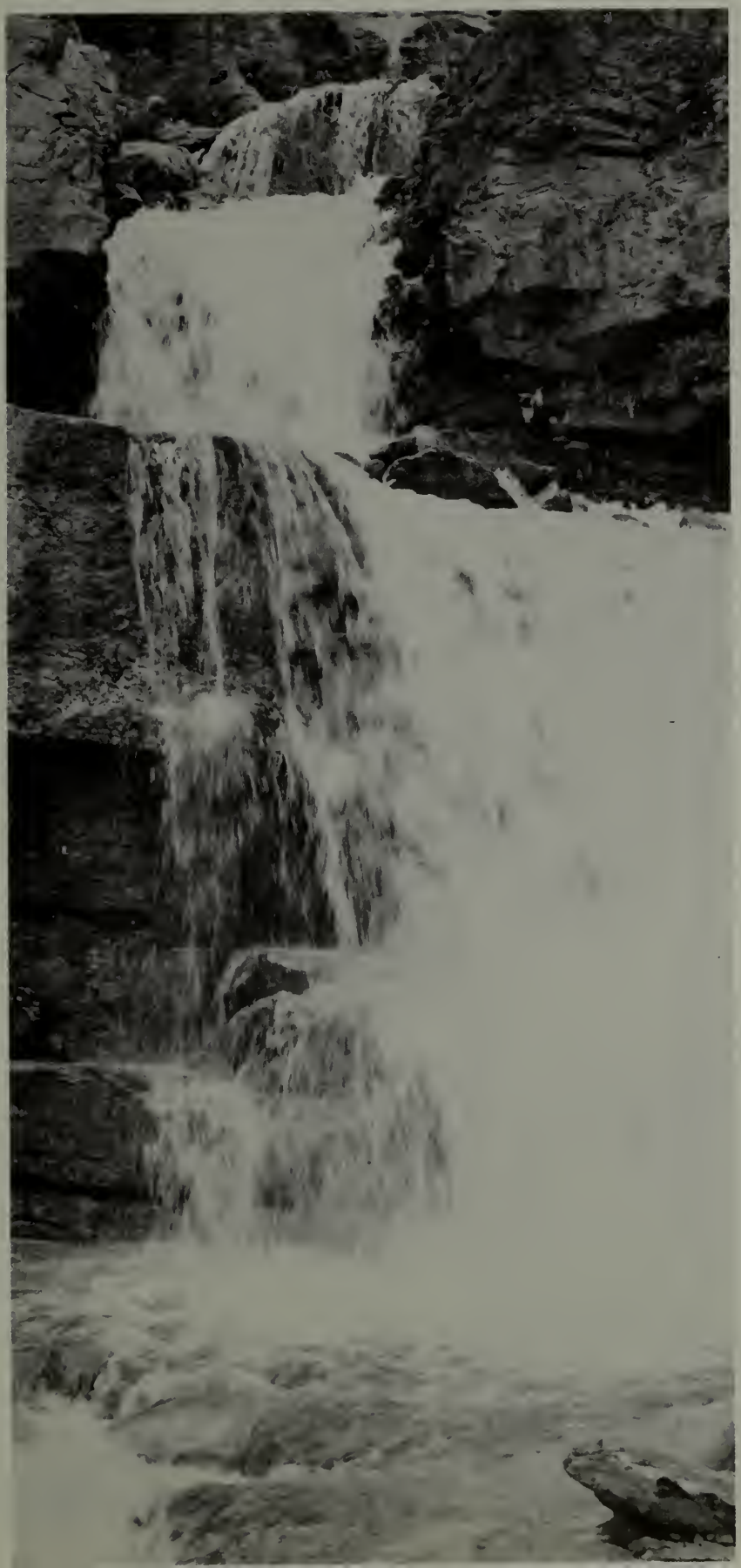
3. Fault - a break in the Earth's crust along which there has been vertical and/or horizontal movement.

4. Igneous rocks - rocks formed by the crystallization of magma, either at depth or at Earth's surface.

5. Mechanical weathering - the physical breakdown of rocks and minerals into smaller pieces at Earth's surface.

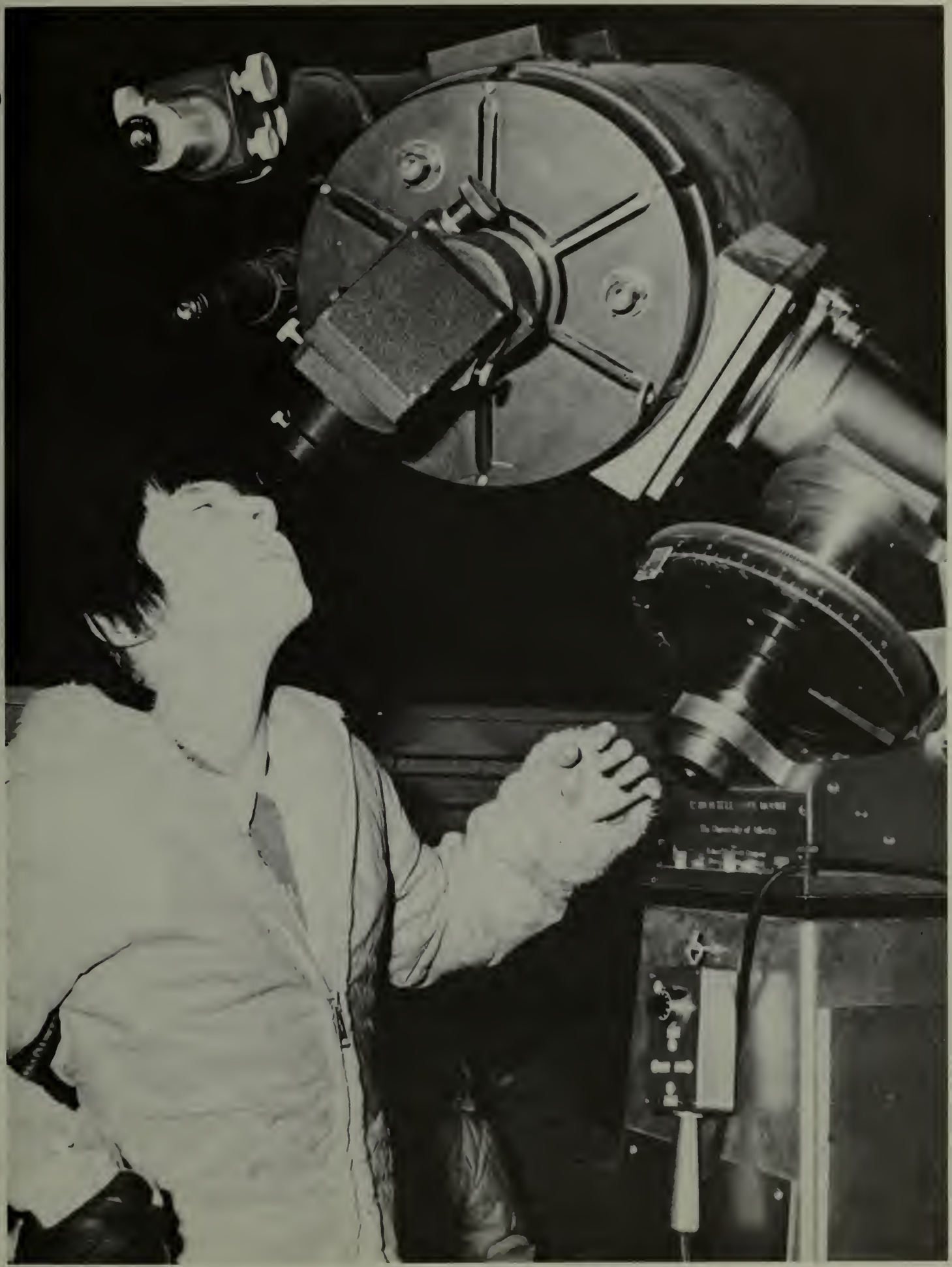
6. Metamorphic rocks - rocks formed at depth from other pre-existing rocks by heat and pressure, or by heat or pressure alone.

7. Sedimentary rocks - rocks that have been formed by sediment particles being cemented together, or solid crystals of some mineral that have been dissolved in water and then precipitated out of solution with or without the aid of organisms.



CORE 8

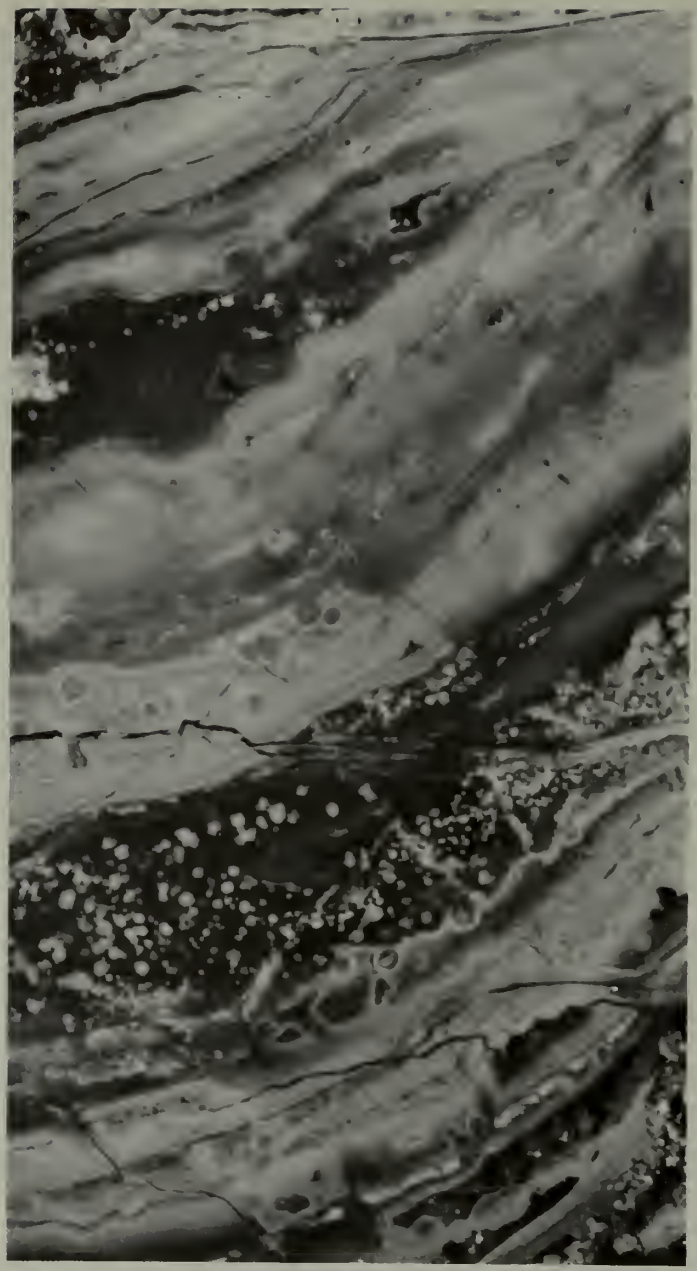
CONCEPT	SUBCONCEPT
C8.1 A perspective of the position and motion of the Earth in space is gained by celestial observation and measurements.	1. Through history man has searched for a systematic way of orienting himself and explaining his observations. 2. The motions of the Earth with respect to its neighbors have a profound effect on man. 3. The many tools and technologies used by Earth-space scientists help develop explanations of the universe. 4. Matter is clustered more densely in some parts of the universe. a. The largest local clusters of matter are galaxies. b. Stars and other celestial bodies can be classified and grouped.
C8.2 Various theories attempt to explain the origin of the solar system and the universe.	1. Man's religions offer an explanation of the Earth's origin. 2. Science views the origins in terms of observable processes. a. Big Bang Theory is widely held as a possible explanation. b. Many others hold that the Steady-State Theory is more acceptable. c. Solar system origins can be explained in other ways.
C8.3 The Sun is a typical star.	Much of what we surmise about the stars comes from our observations of the Sun. a. Radiation from the Sun can be used to investigate its structure, motions, history and processes. b. Solar radiation is both beneficial and harmful to life on its planets.

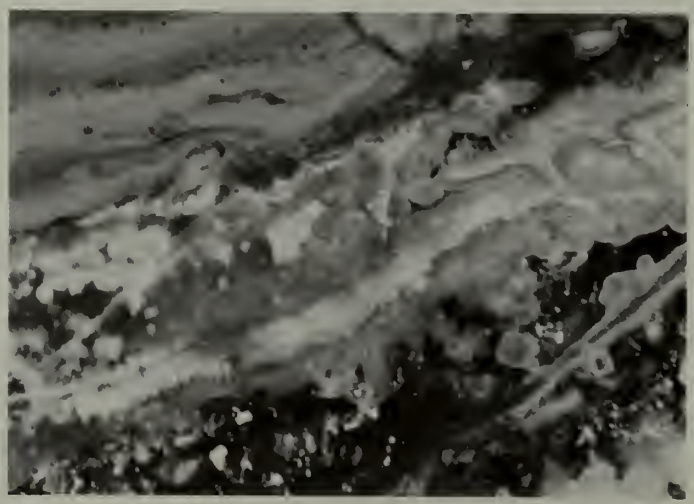


CONCEPT	SUBCONCEPT
C8.4 Solar gravity and planetary inertia maintain a system of planets in orbit.	1. Planetary motion is predictable. 2. The members of this solar system differ in their physical characteristics and dynamic properties. Several planets have satellites of their own. 3. The moon provides an opportunity to study an extra-terrestrial body. a. The Earth and Moon interact. b. The Moon's environment is different from the Earth's.
C8.5 The surface of the Earth and its inhabitants are surrounded by an atmosphere of air.	1. Air is matter. a. Air is a mixture of gases. b. Air has weight and exerts pressure which can be measured. 2. The atmosphere is heated by the Sun's energy which is absorbed by the Earth. a. Radiant energy from the Sun is transformed into heat. Much of the incoming heat is absorbed by the Earth and its oceans. b. Heat absorption by the Earth varies. i. Light colored areas reflect more heat than dark areas. ii. Oceanic areas reflect more heat than continental areas. iii. The angle of the Sun above the horizon affects the heat absorbed. c. Absorbed heat is distributed by a number of mechanisms. i. Radiation is a means by which a warm body loses heat. ii. Convection currents distribute heat quickly and efficiently. iii. The distribution of heat is also achieved by conduction. iv. Heat lost equals heat gained on a global scale.

CONCEPT	SUBCONCEPT
	3. The air of the atmosphere is in constant motion due to unequal heating and the rotation of the Earth. a. There is a pattern to the planetary winds. b. Local winds are affected by land forms and bodies of water.
	4. The water cycle is an important process which involves the atmosphere. a. Water vapor enters the atmosphere by evaporation. b. Water vapor eventually condenses as the air is cooled and becomes saturated.
C8.6 Local conditions in the atmosphere are referred to as weather.	1. Different air masses exist within the atmosphere. a. Fronts form at the boundary between different air masses. i. Fronts can be classified. ii. Changes in weather are often associated with fronts. iii. Violent storms are often associated with fronts. b. High pressure areas often serve to define the extent of air masses. c. Low pressure areas usually form in association with fronts.
	2. Weather reports give information about local and global atmospheric conditions. a. The information is gathered by instruments at weather stations and by weather satellites. b. The information given includes reports of air pressure, air temperature, relative humidity, wind direction and speed, cloud cover and precipitation. c. The weather map is a record of the information gathered and is used to predict future weather.

CONCEPT	SUBCONCEPT
C8.7 The crust of the Earth is formed of rocks.	1. Common minerals are found within the Earth's crust. Most minerals are made up of elements from a group of only nine naturally occurring elements. 2. Rocks are formed from a mineral or a mixture of minerals. 3. Rocks can be categorized into three main groups. a. Initially, all rocks were formed by the cooling magma of the Earth. Texture and mineral content of igneous rocks can be used for identification. b. Erosion and/or deposition form sedimentary rocks. Grain size and/or mineral content of sedimentary rocks can be used for identification. c. Sedimentary and igneous rocks can be reconstituted to form metamorphic rocks. Metamorphic rocks are classified on the basis of their mineral content and structure.
C8.8 The crust of the Earth is constantly being changed.	1. Landforms are being built up by movements within the crust. a. Earthquakes are the result of movements of masses of rock. b. Faulting and folding are the result of large forces in the crust. c. Volcanism is associated with faulting in the crust. 2. Weathering weakens rock formations. a. Mechanical weathering makes small pieces out of large ones. b. Chemical weathering changes the rock itself.





CONCEPT

SUBCONCEPT

3. Erosion changes the landforms.
   a. Erosion is caused by running water.
   b. Erosion is caused by wind.
   c. Erosion is caused by glaciation.
   d. Erosion is caused by groundwater.
   e. Agents of erosion help lay down sediments.

4. Dynamic processes are at work within the Earth.
   a. Forces acting on the crust are due to the structure of the Earth.
   b. Theories have been advanced to explain how forces have acted on the crust to produce the present landforms.

      Continental drift, plate tectonics and sea floor spreading are theories advanced to explain crustal deformation.

CORE CONCEPT REFERENCE GRID -- KEYED TO PRESCRIBED REFERENCES

	CONCEPTS		*Spaceship Earth - Earth Science*	*Challenges to Science - Earth Science*
C8.1	A perspective of the position and motion of the Earth in space is gained by celestial observation and measurements.	1. Through history man has searched for a systematic way of orienting himself and explaining his observations.	(pages) 63-91 577-586	(pages) 309-310 338 342-343 446-451
		2. The motions of the Earth with respect to its neighbors have a profound effect on man.	194-195 597-603	441-442
		3. The many tools and technologies used by Earth-Space scientists help develop explanations of the universe.	4-7 14-21 48-52 55-56 604-607	322-323 367-372 388-390 419-422
		4. Matter is clustered more densely in some parts of the universe.		
		a. The largest local clusters of matter are galaxies.	31-48 53-55	407-418
		b. Stars and other celestial bodies can be classified and grouped.	7-17 575-576 595-596	377-387 399-404 418-419
C8.2	Various theories attempt to explain the origin of the solar system and the universe.	1. Man's religions offer an explanation of the Earth's origin.		
		2. Science views the origins in terms of observable processes.		

		a. Big Bang Theory is widely held as a possible explanation.	56-57	423
		b. Many others hold that the Steady-State Theory is more acceptable.	58-59	422
		c. Solar system origins can be explained in other ways.		
C8.3	The Sun is a typical star.	Much of what we surmise about the stars comes from our observations of the Sun.		
		a. Radiation from the Sun can be used to investigate its structure, motions, history and processes.	107-110 121-122	355-366
		b. Solar radiation is both beneficial and harmful to life on its planets.		
C8.4	Solar gravity and planetary inertia maintain a system of planets in orbit.	1. Planetary motion is predictable.	96-106 609	
		2. The members of this solar system differ in their physical characteristics and dynamic properties.	110-127 608	336-352
		Several planets have satellites of their own.		
		3. The Moon provides an opportunity to study an extra-terrestrial body.	129-147	310-319
		a. The Earth and Moon interact.		
		b. The Moon's environment is different from the Earth's.	148-157	320-329

C8.5	The surface of the Earth and its inhabitants are surrounded by an atmosphere of air.	1. Air is matter.		
		a. Air is a mixture of gases.	174-184	245-254 256-261
		b. Air has weight and exerts pressure which can be measured.	171-173	255
		2. The atmosphere is heated by the Sun's energy which is absorbed by the Earth.		
		a. Radiant energy from the Sun is transformed into heat. Much of the incoming heat is absorbed by the Earth and its oceans.	188-190	264-265
		b. Heat absorption by the Earth varies.	192-197	266-269
		i. Light colored areas reflect more heat than dark areas.		
		ii. Oceanic areas reflect more heat than continental areas.		
		iii. The angle of the Sun above the horizon affects the heat absorbed.		
		c. Absorbed heat is distributed by a number of mechanisms.	190-191 198-199	240-242
		i. Radiation is a means by which a warm body loses heat.		
		ii. Convection currents distribute heat quickly and efficiently.		
		iii. The distribution of heat is also achieved by conduction.		

		iv. Heat lost equals heat gained on a global scale.		
		3. The air of the atmosphere is in constant motion due to unequal heating and rotation of the Earth.		
		a. There is a pattern to the planetary winds.	206-213	270-275
		b. Local winds are affected by land forms and bodies of water.		276
		4. The water cycle is an important process which involves the atmosphere.	200-203	150
		a. Water vapor enters the atmosphere by evaporation.		
		b. Water vapor eventually condenses as the air is cooled and becomes saturated.		
C8.6	Local conditions in the atmosphere are referred to as weather.	1. Different air masses exist within the atmosphere.	228-239	278-280
		a. Fronts form at the boundary between different air masses.	217	
		i. Fronts can be classified.		
		ii. Changes in weather are often associated with fronts.		
		iii. Violent storms are often associated with fronts.		
		b. High pressure areas often serve to define the extent of air masses.		

		c. Low pressure areas usually form in association with fronts.		
		2. Weather reports give information about local and global atmospheric conditions.		
		a. The information is gathered by instruments at weather stations and by weather satellites.	221-222	
		b. The information given includes reports of air pressures, air temperature, relative humidity, wind direction and speed, cloud cover and precipitation.	224-225 613	
		c. The weather map is a record of the information gathered and is used to predict future weather.	218-219 223 225-227	
C8.7	The crust of the Earth is formed of rocks.	1. Common minerals are found within the Earth's crust. Most minerals are made up of elements from a group of only nine naturally occurring elements.	244-246 591-594 615	21-30 429-434
		2. Rocks are formed from a mineral or a mixture of minerals.	247-250	30-41 435-436
		3. Rocks can be categorized into three main groups.		
		a. Initially all rocks were formed by the cooling magma of the Earth. Texture and mineral content of igneous rocks can be used for identification.	247-252	43-50

	b. Erosion and/or deposition form sedimentary rocks.	252-264	64-79
	Grain size and/or mineral content of sedimentary rocks can be used for identification.		
	c. Sedimentary and igneous rocks can be reconstituted to form metamorphic rocks.	265-272	89-96
	Metamorphic rocks are classified on the basis of their mineral content and structure.		
C8.8 The crust of the Earth is constantly being changed.	1. Landforms are being built up by movements within the crust.		
	a. Earthquakes are the result of movements of masses of rock.	299-328	114-122
	b. Faulting and folding are the result of large forces in the crust.	304-309	131-145
	c. Volcanism is associated with faulting in the crust.	275-297	102-113
	2. Weathering weakens rock formations.	333-356	57-64
	a. Mechanical weathering makes small pieces out of large pieces.	336-342	
	b. Chemical weathering changes the rock itself.	343-346	

3.	Erosion changes the landforms.		
	a. Erosion is caused by running water.	368-373	150-152
	b. Erosion is caused by wind.	364-365	166-167
	c. Erosion is caused by glaciation.	360-364	161-165
	d. Erosion is caused by ground water.		158-160
	e. Agents of erosion help lay down sediments.	366-367 374-391	148-149 152-158
4.	Dynamic processes are at work within the Earth.		
	a. Forces acting on the crust are due to the structure of the Earth.	448-457 614	123-127
	b. Theories have been advanced to explain how forces have acted on the crust to produce the present landforms.	424-447	224-230
	Continental drift, plate tectonics and sea floor spreading are theories advanced to explain crustal deformation.		

ELECTIVES 8

GRADE 8 SCIENCE ELECTIVES

The principles to be applied when choosing topics are:

1. The time available is a minimum of 20 hours.

2. The content is related to the core in one of three ways:

   a. An extension of a core topic (breadth).

   b. An in-depth, intensive study of a core topic. (Caution: The topic should not be developed to the extent that is found at a higher grade level.)

   c. A practical application of a core topic.

Learning Resources

For learning resources appropriate to each elective, refer to *Learning Resources--Junior High School Science*, the supplementary publication to this grade.

Elective Topics

A minimum of one elective topic chosen from the following list is to be studied.

E8.1 Materials from the crust have had an important influence on mankind's daily living.

E8.2 Evidence for determining the past history of the earth comes from a study of the crust.

E8.3 Matter in the universe appears to be moving at tremendous velocities.

E8.4 The oceans form a large portion of the earth's surface.

E8.5 A locally developed unit.

Note: Outlines for each elective, with the exception of E8.5 are provided in the Curriculum Guide.

E8.1

MATERIALS FROM THE CRUST HAVE HAD AN IMPORTANT INFLUENCE ON MANKIND'S DAILY LIVING

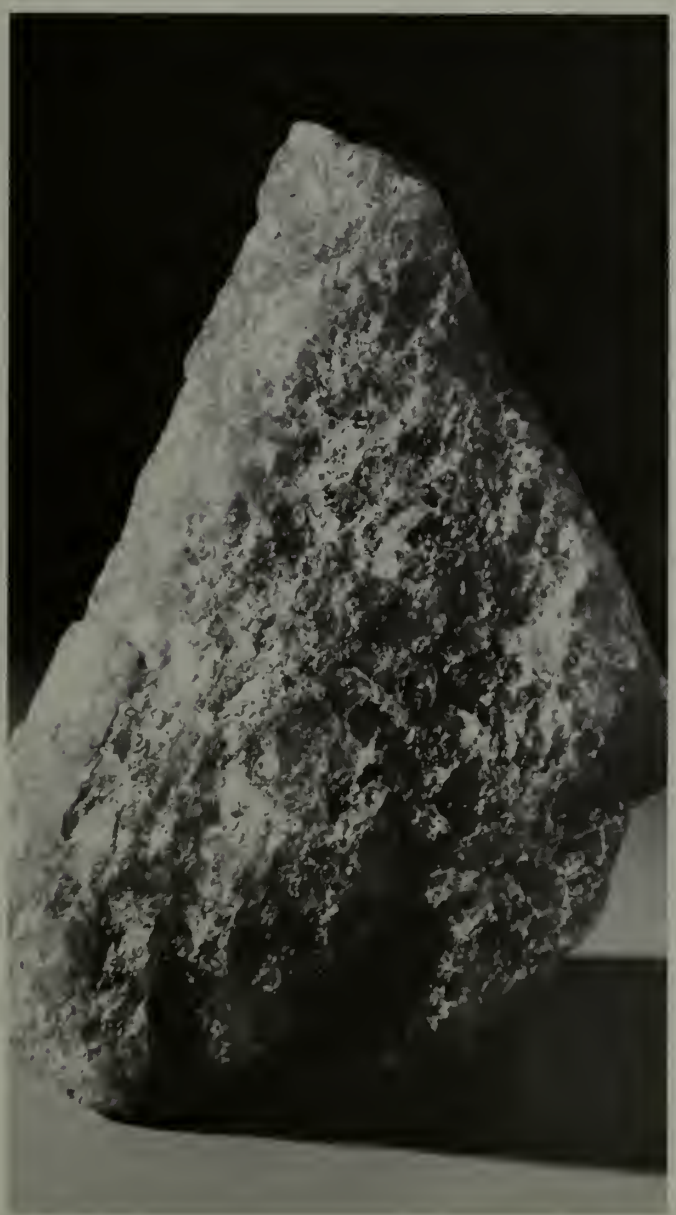
Content:

1. Fossil fuels and their products are important in the economy of Alberta.

2. Since crustal materials are limited, exploitation must be managed for maximum benefit.

References:

Refer to Elective Concept Reference Grid page 74 .



E8.2

EVIDENCE FOR DETERMINING THE PAST HISTORY OF THE EARTH COMES FROM A STUDY OF THE CRUST

Content:

1. Age determinations can be estimated on the basis of rates of changes of crustal materials.
   a. Sediments have been laid down throughout the life of the earth.
   b. Radioactive elements decay at measurable rates.
2. Fossil evidence can be used to relate past events in the history of the earth from one place to another.
   a. There are different kinds of fossil evidence: remains, casts, molds, and replacement fossils.
   b. Earth's history can be divided into periods of geologic time on the basis of the type of fossil evidence.
   c. Fossil evidence is used in oil and gas exploration.

References:

Refer to Elective Concept Reference Grid page 74 .

E8.3

MATTER IN THE UNIVERSE APPEARS TO BE MOVING AT TREMENDOUS VELOCITIES

Content:

1. Interstellar distances are measured in light years and astronomical units.

2. Observations of celestial positions to determine motions in the universe are made over a period of many years.

References:

Refer to Elective Concept Reference Grid page 75 .

E8.4

THE OCEANS FORM A LARGE PORTION OF THE EARTH'S SURFACE

Content:

1. Sediment is sorted after it reaches the sea.
2. The ocean floor builds up slowly.
   a. Currents carry sediments far out to sea.
   b. Sediment deposition can change the shape of the sea floor.
   c. Parts of the ocean floor are sinking.

References:

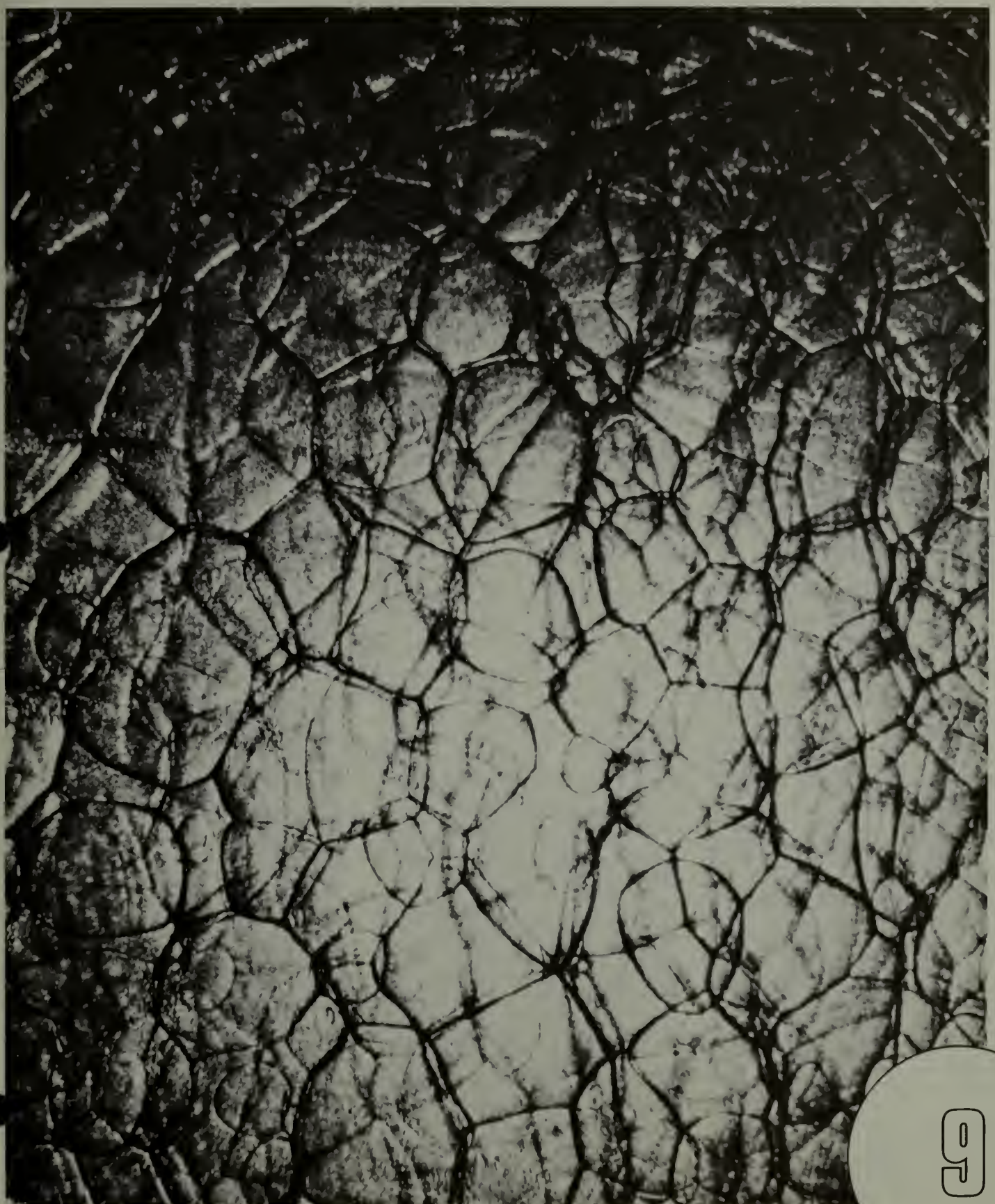
Refer to Elective Concept Reference Grid page 75 .

ELECTIVE CONCEPT REFERENCE GRID -- KEYED TO PRESCRIBED REFERENCES

	CONCEPTS		*Spaceship Earth -- Earth Science*	*Challenges to Science -- Earth Science*
E8.1	Materials from the crust have had an important influence on mankind's daily living.	1. Fossil fuels and their products are important in the economy of Alberta.	(pages)	(pages) 302-305 83-85
		2. Crustal materials are limited and exploitation must be managed for maximum benefit.		50-55 80-82 85-86 97-99 300-301
E8.2	Evidence for determining the past history of the Earth comes from a study of the crust.	1. Age determinations can be estimated on the basis of rates of changes of crustal materials. a. Sediments have been laid down throughout the life of the earth. b. Radioactive elements decay at measurable rates.	461-473	171-174 181-183
		2. Fossil evidence can be used to relate past events in the history of the earth from one place to another. a. There are different kinds of fossil evidence: remains, casts, molds, and replacement fossils.	474-511	175-181 183-185 436-437

		b. Earth's history can be divided into periods of geologic time on the basis of the type of fossil evidence. c. Fossil evidence is used in oil and gas exploration.	
E8.3	Matter in the universe appears to be moving at tremendous velocities.	1. Interstellar distances are measured in light years and astronomical units. 2. Observations of celestial positions to determine motions in the universe are made over a period of many years.	94-98
E8.4	The oceans form a large portion of the Earth's surface.	1. Sediment is sorted after it reaches the sea. 2. The ocean floor builds up slowly. a. Currents carry sediments far out to sea. b. Sediment deposition can change the shape of the sea floor. c. Parts of the ocean floor are sinking.	396-404 404-413 414-420

Physical Science



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Prescribed References

Bickel, C. L., et al, *Physical Science Investigations*. Markham: Houghton Mifflin, 1976.

Carter, J. L., et al, *Physical Science: A Problem Solving Approach*. Scarborough: Ginn and Co., 1977.

Heath, R. W. and R. R. McNaughton, *Physical Science: Interaction of Matter and Energy*. Toronto: D. C. Heath, 1976.

Townsend, R. D. and P. DeH. Hurd, *Energy, Matter and Change*. Agincourt: Gage and Co., 1973.

Learning Resources

For learning resources appropriate to each elective, refer to *Learning Resources--Junior High School Science*, the supplementary publication to this guide.

Objectives

After participating in the activities and completing the assignments associated with this course, the student should be able to:

9.1 Demonstrate a knowledge of and be able to discuss the identified major concepts and their associated subconcepts within the context of a study of physical science. These major concepts are:

- 9.1.1 Matter occupies space and has mass.
- 9.1.2 The forms and behavior of matter can be explained by the Kinetic Molecular Theory.
- 9.1.3 Heat and temperature can be explained in terms of molecular motion.
- 9.1.4 Energy enables work to be done and motion to be changed.
- 9.1.5 Matter is composed of atoms and molecules.

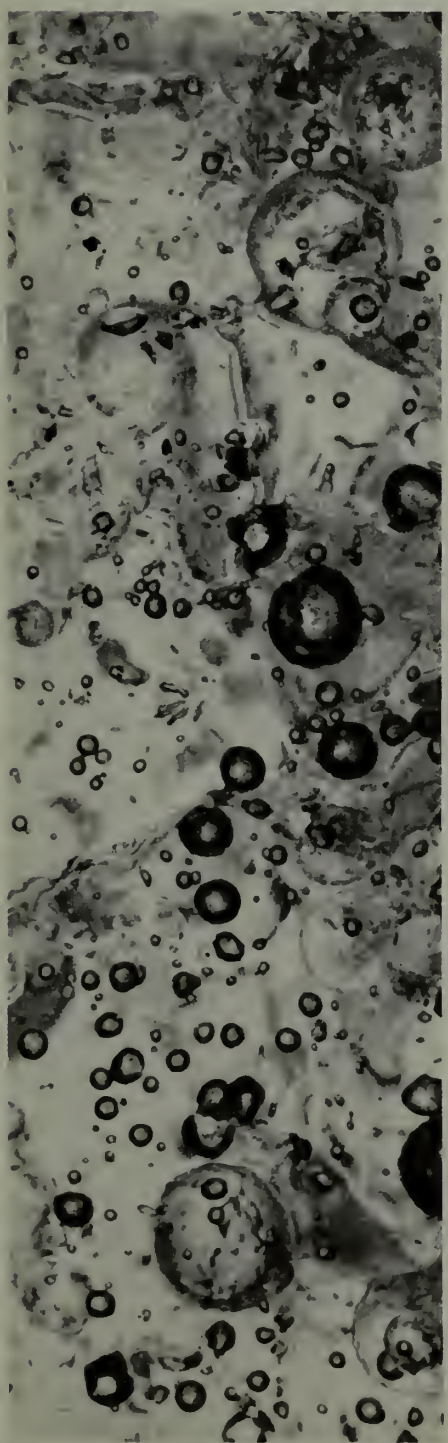
9.2 Demonstrate proficiency in the scientific investigative skills of:

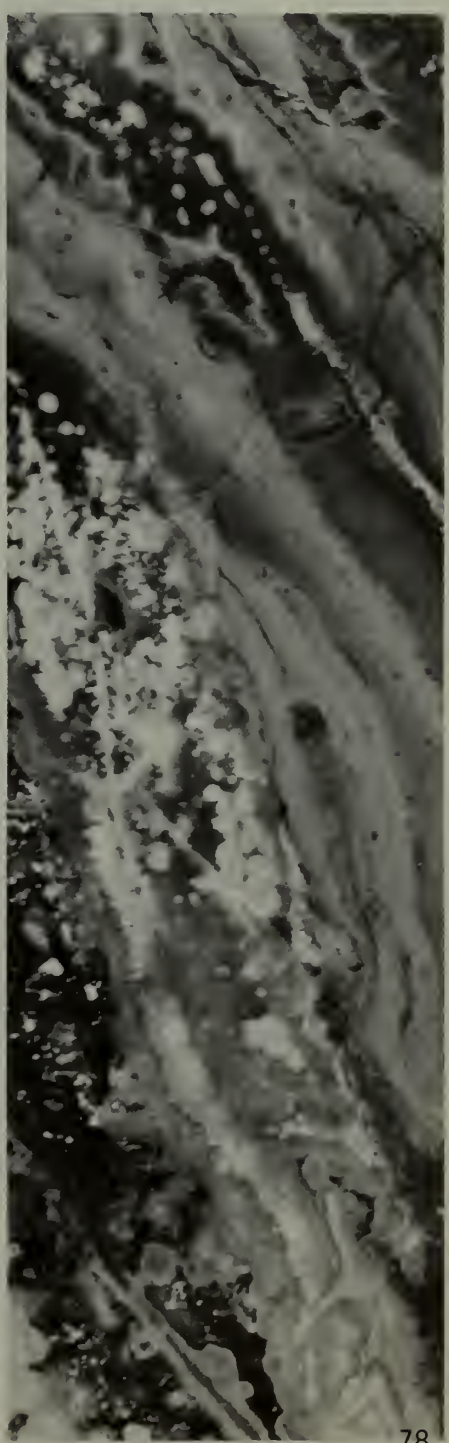
--problem identification
--outlining procedures and safe work habits
--organizing observations and data
--recording results
--making inferences which relate to hypotheses
--predicting future behaviors

9.3 Identify and discuss the development of a major scientific concept such as the Kinetic Molecular Theory as it was explained by Galileo, Bacon, Thompson, Davy and Maxwell.

9.4 Participate in the routine management of the laboratory program by being responsible for the preparation of materials and equipment prior to and following laboratory periods.

9.5 Investigate scientific factors involved with a technological topic such as the development of alternative sources of energy.





DEFINITIONS FOR GRADE NINE SCIENCE

(Arranged topically)

The following definitions are included to aid the teacher of the Grade 9 Science Program.

A. Matter Occupies Space and Has Mass

1. Area - the number of square units of surface.
2. Density - a measure of the mass per unit volume of matter.
3. Mass - the measure of the quantity of matter in an object.
4. Volume - the space occupied by matter.
5. Weight - the measure of the force of gravity acting on an object.

B. Kinetic Molecular Theory

1. Diffusion - the penetration of one type of molecule into matter consisting of a second type of molecule.
2. Evaporation - a process in which fast moving molecules at the surface of a substance leave the liquid state for the gas state.
3. Molecule - the smallest particle of a gas or a compound that has the properties of a larger amount of that gas or compound.

C. Heat and Temperature

1. Heat - a measure of the total energy content of a substance due to a molecular motion.
2. Temperature - a measure of the average kinetic energy content of the molecules of a substance.

D. Energy and Work

1. Energy - the ability or capacity to do work or cause motion.
2. Work - the ability to apply a force which causes an object to move in the same direction as the force.

E. Structure of Matter

1. Atom - the smallest particle of an element that still retains the identity of the element--the building block of matter.

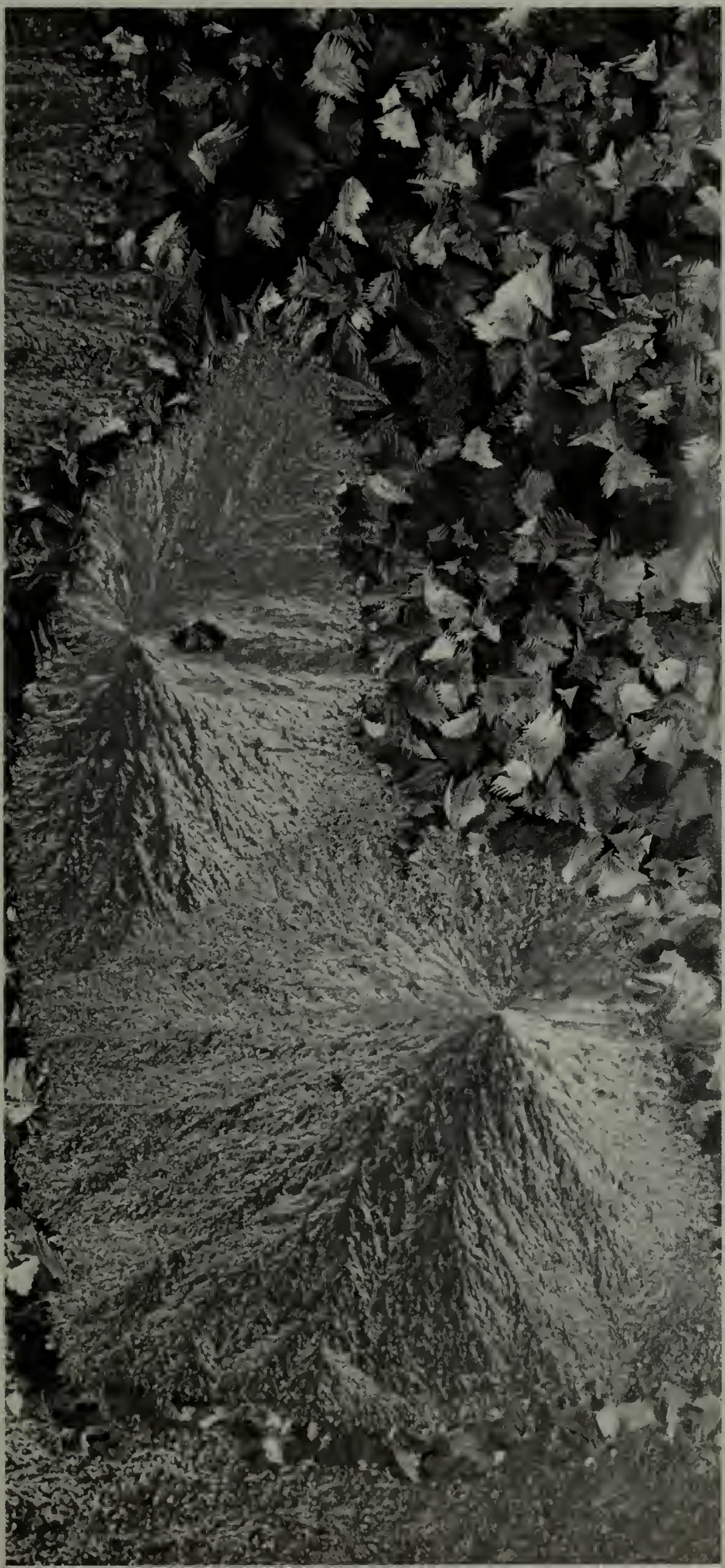
2. Chemical change - atoms are rearranged resulting in new substances with new properties.

3. Physical change - one or more of the properties of a substance are altered but not its composition or identity.

F. Elective Topics

1. Joule - the amount of work done if a force of one newton is applied through a distance of one meter.

2. Joule (heat) - 4.2 joules of heat are required to raise 1 gram of water by 1°C. One calorie of heat is equivalent to 4.2 joules of heat.



CORE 9

CONCEPT	SUBCONCEPT
C9.1 Matter occupies space and has mass.	1. Fundamental to the process of science is the establishment of standards for making measurements. a. The development of standard units and systems of measurement has taken place slowly. b. Good measurement techniques are necessary in order to obtain meaningful data. c. All measurements are approximate. d. Relationships existing between measurement data are often more clearly shown and are more easily understood by using graphs. 2. Matter can be measured by determining its linear dimensions, its surface area and its volume. a. Length, surface area and volume of regular shaped solids can be directly measured. b. Volume of irregularly shaped solids may be found indirectly by liquid displacement. 3. Matter can be measured in terms of its mass and weight. Mass and weight are two different measurements of matter. 4. Density is a characteristic property of any given sample of matter and is, therefore, useful for identification purposes. a. Molecular arrangement influences density. b. Differences in the density of materials accounts for floating and sinking bodies.

CONCEPT	SUBCONCEPT
C9.2 The forms and behavior of matter can be explained by the Kinetic Molecular Theory.	1. Matter is composed of tiny particles. a. Tiny particles of matter are called molecules. b. Molecules vary in size. c. Spaces exist between the molecules of matter. 2. Molecules are in a state of constant motion. a. Brownian movement provides indirect evidence of molecular motion. b. Molecular motion in solids may be vibrational about a fixed position. c. Molecules in liquids may be able to slide or move over one another in random directions. d. Molecules in gases may have considerable freedom of movement in random directions. e. The greater the freedom and rate of movement of molecules of the same kind, the higher their energy content. 3. Molecular movement is the basis for diffusion. a. Diffusion is slow in solids due to limited molecular motion and their closely packed orderly arrangement. b. Diffusion takes place more readily in liquids and gases. c. Rate of diffusion depends on the temperature of the substances. d. Rate of diffusion depends on the size of the molecules involved. e. Dissolving is a form of diffusion. f. Solutions are formed when molecules of one substance spread out evenly throughout another substance. No boundaries between components of a solution can be observed.

CONCEPT	SUBCONCEPT
	4. Molecular motion results in evaporation.
	a. Evaporation involves a change in state from a liquid to a gas.
	b. Evaporation occurs as faster moving molecules near the surface escape.
	c. Evaporation produces a cooling effect.
	d. Different liquids evaporate at different rates.
	e. Rate of evaporation of a given liquid depends on:
	i. Temperature of the liquid.
	ii. Vapor content of the air above.
	iii. Movement of air across the liquid surface.
	iv. Surface area of the liquid that is in contact with the air.
C9.3 Heat and temperature can be explained in terms of molecular motion.	1. Heat and temperature are related.
	a. Temperatures may be measured indirectly by utilizing the response of matter to changes in temperature.
	i. An arbitrarily chosen standard is necessary in the construction of most temperature scales.
	ii. Several temperature scales have been devised: - Celsius - Kelvin - others
	b. Heat is measured indirectly by the effects it produces.
	i. Heat is measured by observing temperature changes of a known mass of water at a known initial temperature.
	ii. Heat is measured in joules.

c. Different substances absorb or release different amounts of heat, even though they have similar masses and undergo similar temperature changes.

i. The heat capacity of water is greater than that of most other substances.

ii. Substances having high heat capacities are good coolants.

d. When a body at higher temperature is in contact with a body at a lower temperature, heat flows from the first to the second body.

i. Heat is conserved in that heat lost by one body is gained by the other.

ii. Heat may be transferred by conduction, convection, or radiation.

2. Matter exists in different states.

a. Matter can exist in solid, liquid or gas form.

Each state is characterized by definite general properties.

b. The addition or removal of heat causes matter to change state.

c. As any given pure substance changes state, its properties change, its composition does not.

d. Temperature remains constant during a change of state.

3. A relationship exists between molecular motion and the volume occupied by matter.

a. With few exceptions, the volume of a solid increases as molecular vibrational motion increases.

b. With the exception of water at temperatures below 4°C, liquids increase in volume as molecular motion increases.

c. All gases, at constant pressure, expand uniformly as molecular motion increases.

CONCEPT	SUBCONCEPT
C9.4 Energy enables work to be done and motion to be changed.	1. Energy may be described as either kinetic or potential energy. 2. Energy is present in the universe in several forms: - electrical energy - chemical energy - mechanical energy - heat energy - light energy - nuclear energy - gravitational energy - magnetic energy 3. One form of energy may be changed into another.
C9.5 Matter is composed of atoms and molecules.	1. Theories and/or models have been developed to assist in understanding atoms. a. All matter is made up of atoms. b. The atomic model has an internal structure consisting of protons and neutrons forming a central core or nucleus, and an outer structure of electrons. c. The various kinds of atoms are called elements. 2. A relationship exists between atoms and molecules. Atoms can exist individually or in combination with other atoms of the same or different elements and, therefore, are the building blocks of molecules. 3. A relationship exists among elements, compounds and mixtures. 4. There is a difference between physical and chemical changes. a. Several examples of physical change are observable: i. Physical properties of matter are determined by inter-molecular distances and forces.

CONCEPT

SUBCONCEPT

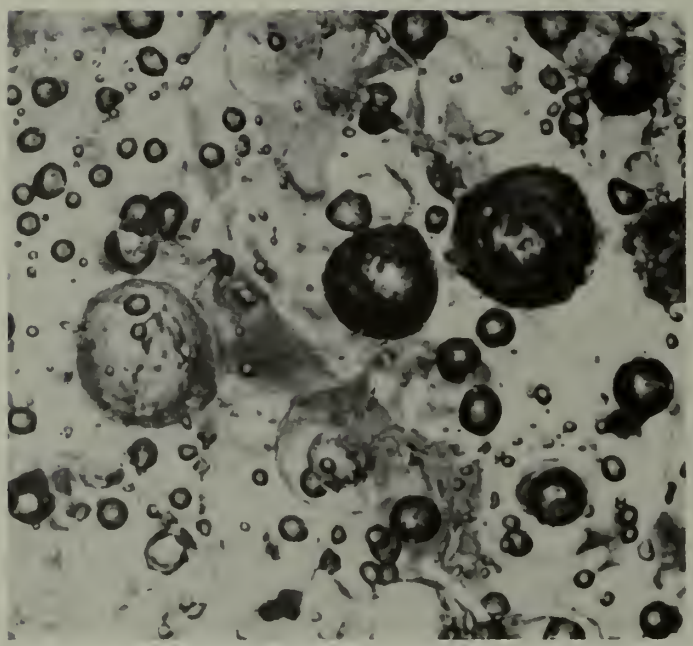
ii. A change in state represents one of the most common physical changes.

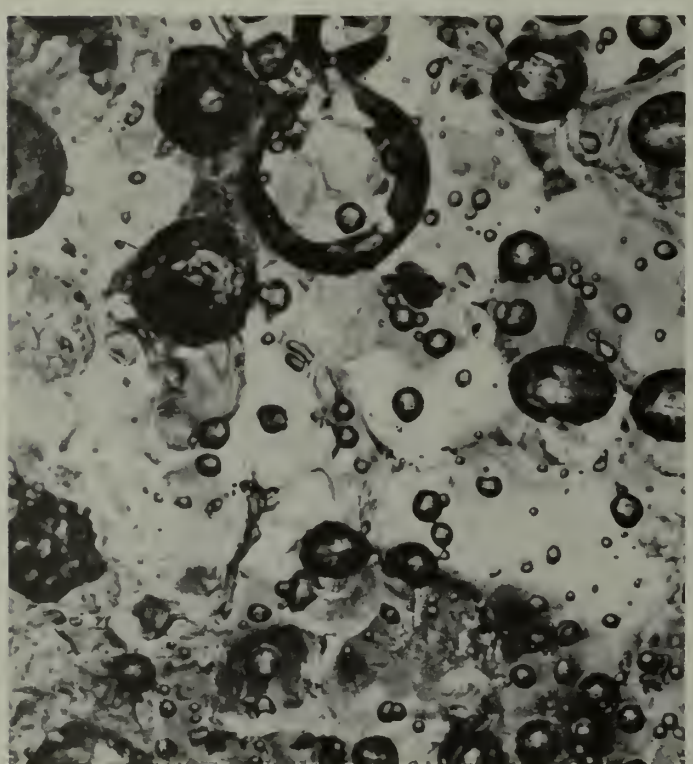
iii. Changes in molecular motion and inter-molecular distances and forces of attraction (adhesion, cohesion) also account for physical changes.

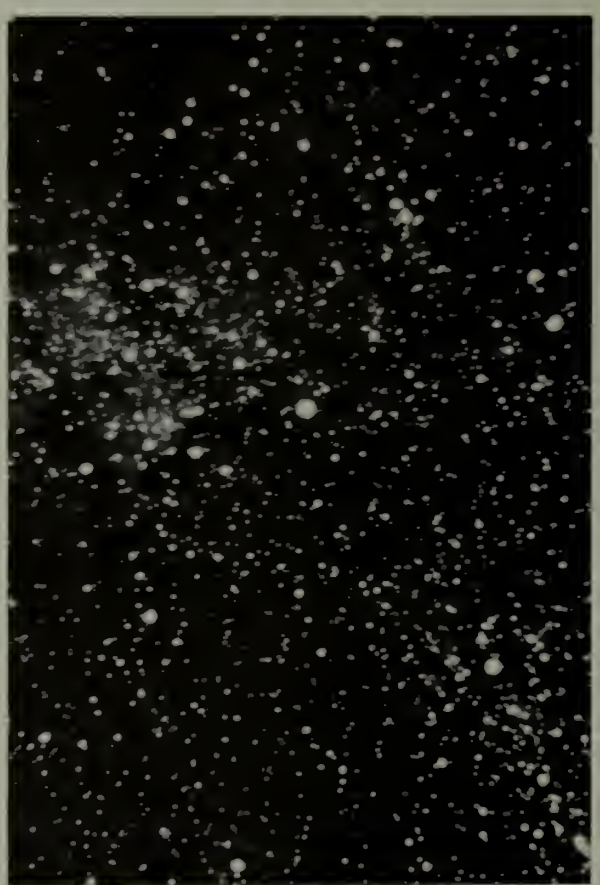
b. Several examples of chemical change are observable:

i. Molecular composition determines the chemical properties of matter.

ii. Most chemical changes require a great deal more energy than do physical changes.







CORE CONCEPT REFERENCE GRID -- KEYED TO PRESCRIBED REFERENCES

Texts:
1. *Physical Science - A Problem Solving Approach*
2. *Physical Science Investigations*
3. *Energy, Matter and Change*
4. *Physical Science - Interaction of Matter and Energy*

	CONCEPTS		1.	2.	3.	4.
			(pages)	(pages)	(pages)	(pages)
C9.1	Matter occupies space and has mass.	1. Fundamental to the process of science is the establishment of standards for making measurements.				
		a. The development of standard units and systems of measurement has taken place slowly.	1-10	9-11	241-245 513-515	12-14
		b. Good measurement techniques are necessary in order to obtain meaningful data.	10-14			
		c. All measurements are approximate.	14-18			
		d. Relationships existing between measurement data are often more clearly shown and are more easily understood by using graphs.	49-60	17-21		15-19
		2. Matter can be measured by determining its linear dimensions, its surface area and its volume.				
		a. Length, surface area and volume of regular shaped solids can be directly measured.	18-21 28-34	14-17 23-24 29-31		24
		b. Volume of irregularly shaped solids may be found indirectly by liquid displacement.	35-39	26-27		

	3. Matter can be measured in terms of its mass and weight. Mass and weight are two different measurements of matter.	21-25	11-14 44-45 64-67	227-231	28-29
	4. Density is a characteristic property of any given sample of matter and is, therefore, useful for identification purposes.				
	a. Molecular arrangement influences density.	47-48			31 81-83
	b. Differences in the density of materials accounts for floating and sinking bodies.	60-70	22 31-37		88-93 85
C9.2 The forms and behavior of matter can be explained by the Kinetic Molecular Theory.	1. Matter is composed of tiny particles.				
	a. Tiny particles of matter are called molecules.				47-48
	b. Molecules vary in size.				52-59
	c. Speaces exist between the molecules of matter.				63-73
	2. Molecules are in a state of constant motion.				
	a. Brownian movement provides indirect evidence of molecular motion.				152-154
	b. Molecular motion in solids may be vibrational about a fixed position.				

c. Molecules in liquids may be able to slide or move over one another in random directions.		
d. Molecules in gases may have considerable freedom of movement in random directions.		
e. The greater the freedom and rate of movement of molecules of the same kind, the higher their energy content.		
3. Molecular movement is the basis for diffusion.	386-387	141-149
a. Diffusion is slow in solids due to limited molecular motion and their closely packed orderly arrangement.		
b. Diffusion takes place more readily in liquids and gases.		
c. Rate of diffusion depends on the temperature of the substance.		
d. Rate of diffusion depends on the size of the molecules involved.		
e. Dissolving is a form of diffusion.		25 34-35
f. Solutions are formed when molecules of one substance spread out evenly throughout another substance.		
No boundaries between components of a solution can be observed.		

	4. Molecular motion results in evaporation.				
	a. Evaporation involves a change in state from a liquid to a gas.		116		
	b. Evaporation occurs as faster moving molecules near the surface escape.		119-120		155-156
	c. Evaporation produces a cooling effect.				
	d. Different liquids evaporate at different rates.				
	e. Rate of evaporation of a given liquid depends on several factors.				
	i. Temperature of the liquid.				
	ii. Vapor content of the air above.				
	iii. Movement of air across the liquid surface.				
	iv. Surface area of the liquid that is in contact with the air.				
C9.3 Heat and temperature can be explained in terms of molecular motion.	1. Heat and temperature are related.				34 99-101
	a. Temperatures may be measured indirectly by utilizing the response of matter to changes in temperature.	197-198	85-89 109-110	320-347	
	i. An arbitrarily chosen standard is necessary in the construction of most temperature scales.				

ii. Several Temperature scales have been devised: - Celsius - Kelvin - Others				
b. Heat is measured indirectly by the effects it produces.	198-203	94-95 104-108	348-361	103
i. Heat is measured by observing temperature changes of a known mass of water at a know initial temperature.				
ii. Heat is measured in joules.				
c. Different substances absorb or release different amounts of heat, even though they have similar masses and undergo similar temperature changes.	207-213	95-98 111-112	362-365	102 108-110
i. The heat capacity of water is greater than that of most other substances.				
ii. Substances having high heat capacities are good coolants.				
d. When a body at higher temperature is in contact with a body at a lower temperature, heat flows from the first to the second body.	187-188 203-207	90-93 111		104-108
i. Heat is conserved in that heat lost by one body is gained by the other.				
ii. Heat may be transferred by conduction, convection, or radiation.				

2. Matter exists in different states.				
a. Matter can exist in solid, liquid or gas form. Each state is characterized by definite general properties.		98	383-385	119
b. The addition or removal of heat causes matter to change state.		101	374-380	120-127
c. As any given pure substance changes state, its properties change, its composition does not.				
d. Temperature remains constant during a change of state.				
3. A relationship exists between molecular motion and the volume occupied by matter.	192-196	106-107		
a. With few exceptions the volume of a solid increases as molecular vibrational motion increases.				
b. With the exception of water at temperatures below $4^{o}C$, liquids increase in volume as molecular motion increases.			381-382	
c. All gases, at constant pressure, expand uniformly as molecular motion increases.		142-144		150-151

C9.4	Energy enables work to be done and motion to be changed.	1. Energy may be described as either kinetic or potential energy.	183-185	69-78	306-309	187-190
		2. Energy is present in the universe in several forms.	183-185		302	193-197
		i. electrical energy				
		ii. chemical energy				
		iii. mechanical energy				
		iv. heat energy				
		v. light energy				
		vi. nuclear energy				
		vii. gravitational energy				
		viii. magnetic energy				
		3. One form of energy may be changed into another.	183-185	70-73	432-433 354-355 50	190-191
C9.5	Matter is composed of atoms and molecules.	1. Theories and/or models have been developed to assist in understanding atoms.				
		a. All matter is made up of atoms.	327-328	165 173-174	440-443	
		b. The atomic model has an internal structure consisting of protons and neutrons forming a central core or nucleus, and an outer structure of electrons.		170-172 177,181		
		c. The various kinds of atoms are called elements.	330-331			

2. A relationship exists between atoms and molecules.	328-329	106 228-229		205
Atoms can exist individually or in combination with other atoms of the same or different elements and, therefore, are the building blocks of molecules.				
3. A relationship exists among elements, compounds and mixtures.	328-329 336-339	106 182-191 223-227	408-418	
4. There is a difference between physical and chemical changes.	329			
a. Several examples of physical change are observable.	157-168 332-336 340-343	174-176 194	374-378	128-132 205-213
i. Physical properties of matter are determined by intermolecular distances and forces.				
ii. A change in state represents one of the most common physical changes.				
iii. Changes in molecular motion and intermolecular distances and forces of attraction (adhesion, cohesion) also account for physical changes.				

b. Several examples of chemical change are observable. i. Molecular composition determines the chemical properties of matter. ii. Most chemical changes require a great deal more energy than do physical changes.	344-354	178-180 194	426-431	221-222

ELECTIVES 9

GRADE 9 SCIENCE ELECTIVES

The principles to be applied when choosing topics are:

1. The time available is a minimum of 20 hours.

2. The content is related to the core in one of three ways:

   a. An extension of a core topic (breadth).

   b. An in-depth, intensive study of a core topic. (Caution: The topic should not be developed to the extent found at a higher grade level.)

   c. A practical application of a core topic.

Learning Resources

For learning resources appropriate to each elective, refer to *Learning Resources--Junior High School Science*, the supplementary publication to this guide.

Elective Topics

Elective topics are to be chosen from the following list. A minimum of two electives is required. If E9.1 is chosen, it is expected that two parts (minimum) are to be done.

E9.1 Many forms of energy exist which can be transferred from place to place or converted from one form to another.

   1. Work represents a transfer of energy (simple machines).

   2. Electrical energy can do work and be changed to other forms of energy.

   3. Light energy can do work and be changed to another form of energy.

   4. The energy of sound plays a significant role in mankind's daily living.

E9.2 Liquid pressure can be used to reduce the force required to move an object.

E9.3 Latent heat accounts for the energy required to cause a change in the state of a substance.

E9.4 A locally developed unit.

Note: Outlines for each elective, with the exception of E9.4 are provided in the Curriculum Guide.

E9.1

MANY FORMS OF ENERGY EXIST WHICH CAN BE TRANSFERRED FROM PLACE TO PLACE OR CONVERTED FROM ONE FORM TO ANOTHER

9.1.1 Work represents a transfer of energy (simple machines).

Content:

a. Units of measurement have been devised which quantitatively express force, distance and work.

   a. Force is measured in newtons.

   b. Distance is measured in metres.

   c. Work is measured in joules.

b. Machines transfer energy from place to place in order to do work advantageous to man.

   --Machines (inclined planes, simple pulleys and pulley systems, and simple levers) are devices man uses to multiply force, to change the direction of a force, to gain speed, or to gain distance.

References:

Refer to Elective Concept Reference Grid page 108.

2. Electrical energy can do work and be changed to other forms of energy.

Content:

a. Experiments by early scientists have enabled us to understand the nature of electricity:

   i. static electricity

   ii. current electricity

   iii. voltaic cells

   iv. magnetic effects of current electricity

2. Simple circuits can be designed to help us understand how electricity can be controlled and used. Study of circuits should be limited to the following:

   i. conductors

   ii. insulators

   iii. series circuits

   iv. parallel circuits

   v. voltmeter

   vi. ammeter

   vii. switches

   viii. electrical terms (watts, volts, amperes)

3. Electrical energy can be used to do work.

   i. sources of electrical energy

   ii. alternating current and direct current

   iii. generators

   iv. electromagnets

   v. transformers

   vi. simple motors

   vii. telegraph and telephone

d. Electrical energy can be changed to other forms of energy.

   i. light energy (light bulbs)

   ii. heat energy (resistance)

   iii. magnetic energy (electromagnets)

References:

Refer to Elective Concept Reference Grid page 109 .

3. Light energy can do work and be changed to another form of energy.

Content:

a. Light can be broken up into several colors.
   --Prisms can be used to break light into a spectrum.

b. Theories have been developed to explain the nature of light:

   i. Particle Theory

   ii. Wave Theory

c. Light can be reflected and refracted.

   i. Mirrors can be used to reflect light.

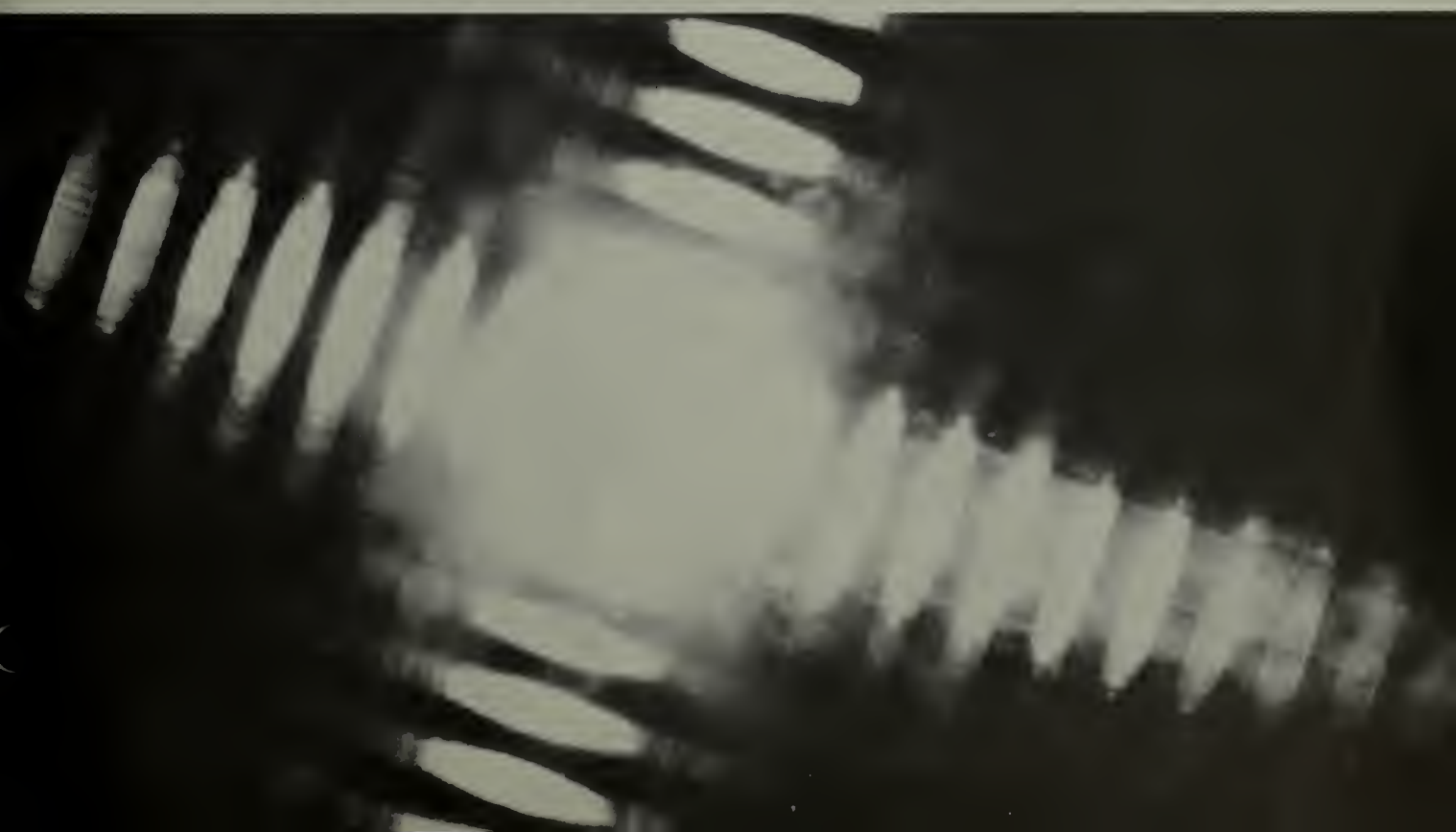
   ii. Lenses can be used to refract light.

d. Light energy can be used to do work.
   --A radiometer is an example of how light energy can do work.

e. Light energy can be changed to another form of energy.
   --Sunlight can be changed to heat energy.

References:

Refer to Elective Concept Reference Grid page 110 .



4. The energy of sound plays a significant role in mankind's daily living.

Content:

a. Sound energy results from vibrations of particles.

   i. Compression and rarefraction waves explain the alternating compression and expansion of matter.

   ii. Sound can be intensified through resonance.

   iii. Pitch is a characteristic of sound.

b. Musical instruments may be a source of pleasant sound.

   i. String instruments

   ii. Wind instruments

   iii. Percussion instruments

c. Sound can be received from a source and recorded.

   i. Ears are designed to receive vibrations and transmit impulses to the brain.

   ii. Telephone receivers change electrical impulses into vibrations.

   iii. Phonograph records and cassette tapes are used to record sounds.

References:

Refer to Elective Concept Reference Grid page 111.

E9.2

LIQUID PRESSURE CAN BE USED TO REDUCE THE FORCE REQUIRED TO MOVE AN OBJECT

Content:

1. Objects place in liquids are subject to an upward buoyant force.
2. Hydraulic systems are an application of liquid pressure used to reduce force required to move an object.

References:

Refer to Elective Concept Reference Grid page 112.

E9.3

LATENT HEAT ACCOUNTS FOR THE ENERGY REQUIRED TO CAUSE A CHANGE IN THE STATE OF A SUBSTANCE

Content:

1. Heat is required or released as matter changes from a solid to a liquid, or a liquid to a solid (latent heat of fusion).

2. Heat is required or released as matter changes from a liquid to a gas, or a gas to a liquid (latent heat of vaporization).

References:

Refer to Elective Concept Reference Grid page 113.

ELECTIVE CONCEPT REFERENCE GRID -- KEYED TO PRESCRIBED REFERENCES

Texts:
1. *Physical Science - A Problem Solving Approach*
2. *Physical Science Investigations*
3. *Energy, Matter and Change*
4. *Physical Science - Interaction of Matter and Energy.*

	CONCEPTS		1.	2.	3.	4.
E9.1	Many forms of energy exist which can be transferred from place to place or converted from one form to another. (Minimum of two must be studied).	1. Work represents a transfer of energy. (simple machines)	(pages)	(pages)	(pages)	(pages)
		a. Units of measurement have been devised which quantitatively express force, distance, and work.	95-125	41-45 49-50 52 62-66	253-275 299-319	165-168
		i. Force is measured in newtons.				
		ii. Distance is measured in metres.				
		iii. Work is measured in joules.				
		b. Machines transfer energy from place to place in order to do work advantageous to man.	128-154	43-83	276-298	168-172
		Machines (inclined planes, simple pulleys and pulley systems, and simple levers) are devices man uses to multiply force, to change the direction of a force, to gain speed, or to gain distance.				

2. Electrical energy can do work and can be changed to other forms of energy.			
a. Experiments of early scientists have enabled us to understand the nature of electricity.	278-288	166-170 181 243-248 280-284	120-124 131-141 148-167 204-211
i. static electricity			
ii. current electricity			
iii. Voltaic cells			
iv. magnetic effects of current electricity			
b. Simple circuits can be designed to help us understand how electricity can be controlled and used. Study of circuits should be limited to the following:	306-323	249-260 284-287	125-130 142-147
i. conductors			
ii. insulators			
iii. series circuits			
iv. parallel circuits			
v. voltmeter			
vi. ammeter			
vii. switches			
viii. electrical terms (watts, volts, amperes)			

c. Electrical energy can be used to do work.	289-304	289-290 295	168-175 188-203	176-178
i. sources of electrical energy				
ii. alternating current and direct current				
iii. generators				
iv. electromagnets				
v. transformers				
vi. simple motors				
vii. telegraph and telephone				
d. Electrical energy can be changed to other forms of energy.	289-291	291-295	148-152 168-170 183-187	
i. light energy (light bulbs)				
ii. heat energy (resistance)				
iii. magnetic energy (electromagnets)				
3. Light energy can do work and can be changed to another form of energy.				
a. Light can be broken up into several colors.			6-31	
Prisms can be used to break light into a spectrum.				

b. Theories have been developed to explain the nature of light.	218-221	333	59-65 76-77 104-107	
i. Particle Theory				
ii. Wave Theory				
c. Light can be reflected and refracted.	230-258	310-330 333-347	32-58 67-74 78-94	
i. Mirrors can be used to reflect light.				
ii. Lenses can be used to refract light.				
d. Light energy can be used to do work.			108-111	178-179
A radiometer is an example of how light energy can do work.				
e. Light energy can be changed to another form of energy.			108-111	
Sunlight can be changed to heat energy.				
4. The energy of sound plays a significant role in mankind's daily living.				
a. Sound energy results from vibrations of particles.	261-263 265-267 269-276			
i. Compression and rarefraction waves explain the alternating compression and expansion of matter.				

		ii. Sound can be intensified through resonance.			
		iii. Pitch is a characteristic of sound.			
		b. Musical instruments may be a source of pleasant sound.	264		
		i. string instruments			
		ii. wind instruments			
		iii. percussion instruments			
		c. Sound can be received from a source and recorded.	268-269		
		i. Ears are designed to receive vibrations and transmit impulses to the brain.			
		ii. Telephone receivers change electrical impulses into vibrations.			
		iii. Phonograph records and cassette tapes are used to record sounds.			
E9.2	Liquid pressure can be used to reduce the force required to move an object.	1. Objects placed in liquids are subject to an upward buoyant force.	70	127-134 144-148	85-86
		2. Hydraulic systems are an application of liquid pressure used to reduce force required to move an object.			

E9.3	Latent heat accounts for the energy required to cause a change in state of a substance.	1. Heat is required or released as matter changes from a solid to a liquid, or a liquid to a solid. (latent heat of fusion)	213-215	101-104 113-115
		2. Heat is required or released as matter changes from a liquid to a gas, or a gas to a liquid (latent heat of vaporization).		117-120